NATIONAL PAVEMENT EVALUATION CONFERENCE 2014

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SURVEY AND ANALYSIS OF THE PAVEMENT STRUCTURE AT NETWORK AND PROJECT LEVELS

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TRADITIONAL ROAD NETWORK MANAGEMENT

- Approach and experience of the responsible technicians
- Visual (manual) inspection
- Specific static tests
- Correction actions using this information

CURRENT SITUATION

INCREASE OF NETWORK LENGTH (km) AND TRAFFIC

NEW ROAD NETWORK MANAGEMENT IS REQUIRED

- Change in road management principles. New idea on road conservation management
- A **Preventive Conservation** is applied (to optimize resources and investments), instead of a Corrective Conservation
- Use of performance **indicators**
- Person in charge of construction and conservation during a long period of time
- Bonus or penalties received depend on the achievement of targets for the performance indicators

1. Introduction

THIS NEW ROAD NETWORK MANAGEMENT aproach allows to:

- Maintain quality and safety levels;
- Control the cost of actions;
- Optimize resources and investment.

Sufficient information to optimize the management is required

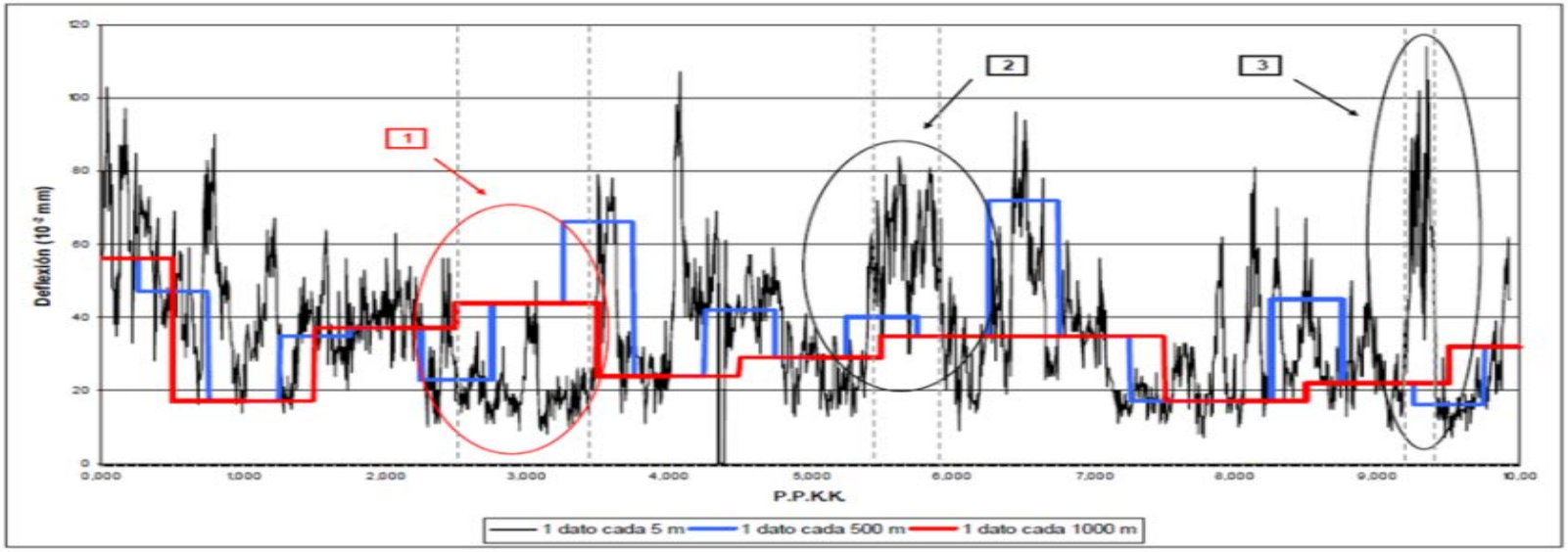
- **High performance devices**
- **High sample rate**

a) High performance devices

- Collecting many data in a short period of time
- Minimizing time of lane occupation (closing of the lane is not required)
- Increasing road safety (less lane disruption time)

b) High sample rate

- Useful real information of the pavement is collected
- Resources and investments are really optimized



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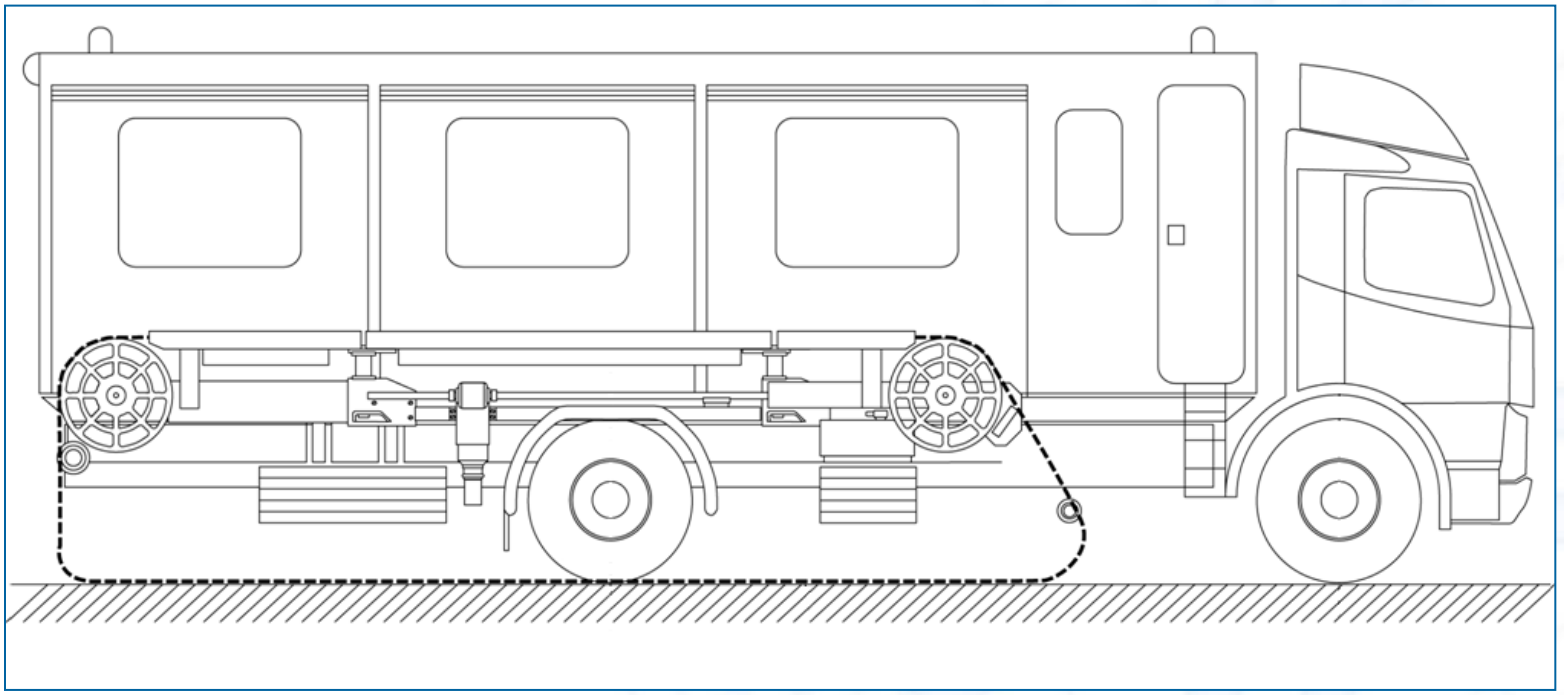
2. Curviameter System

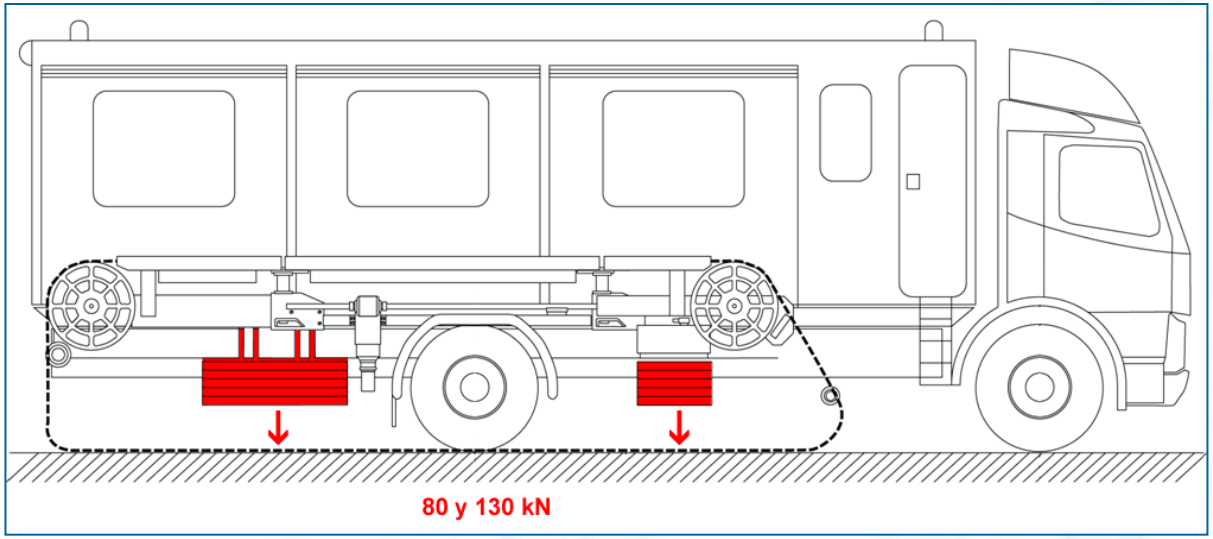
Device. **CURVIAMETER**

2. Curviameter System

Device. **CURVIAMETER**

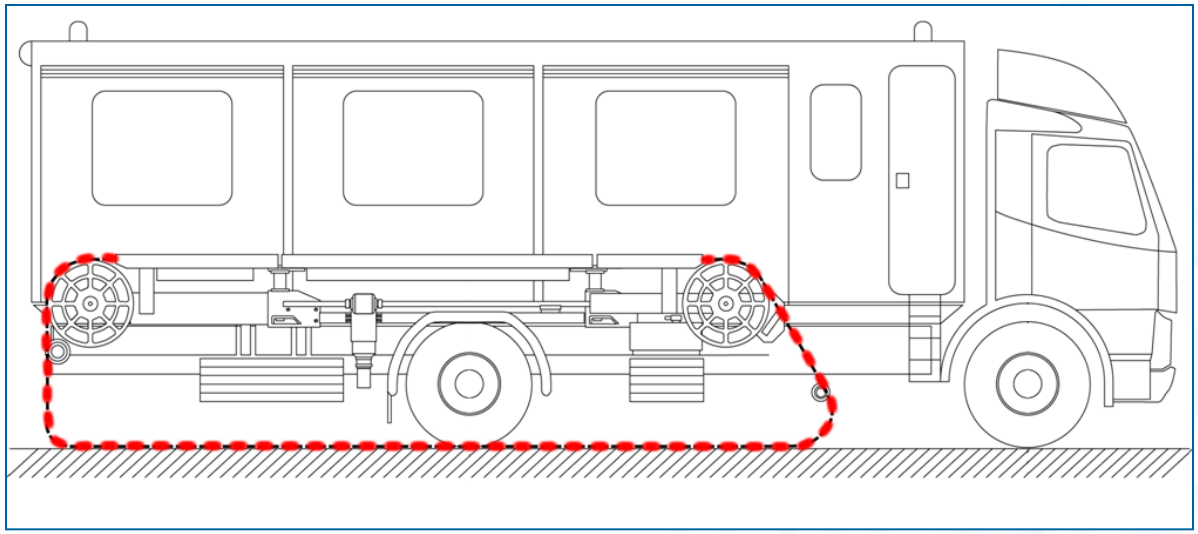


CURVIAMETER. Modular load

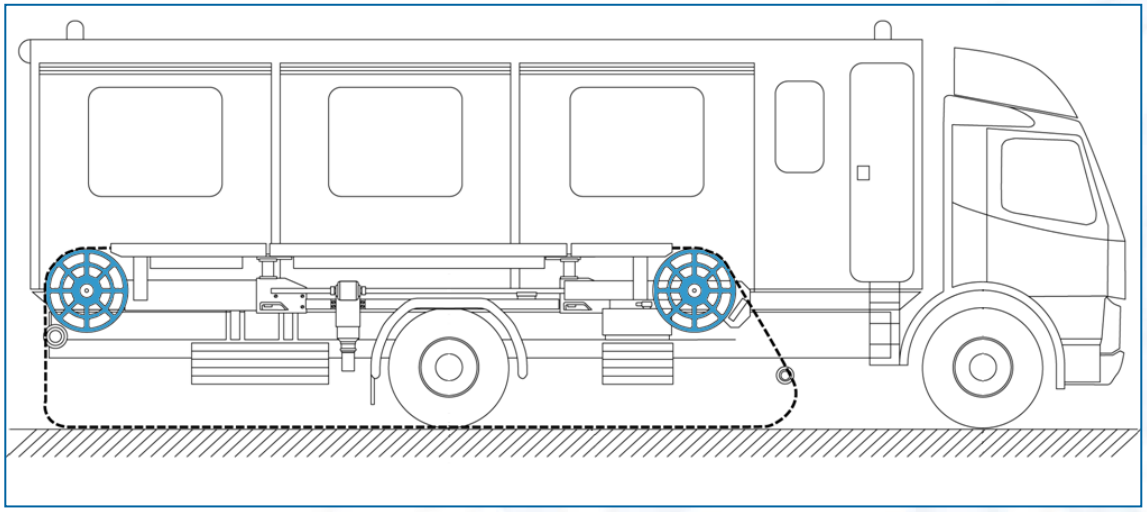


2. Curviameter System

CURVIAMETER. Chain



CURVIAMETER. Movement system



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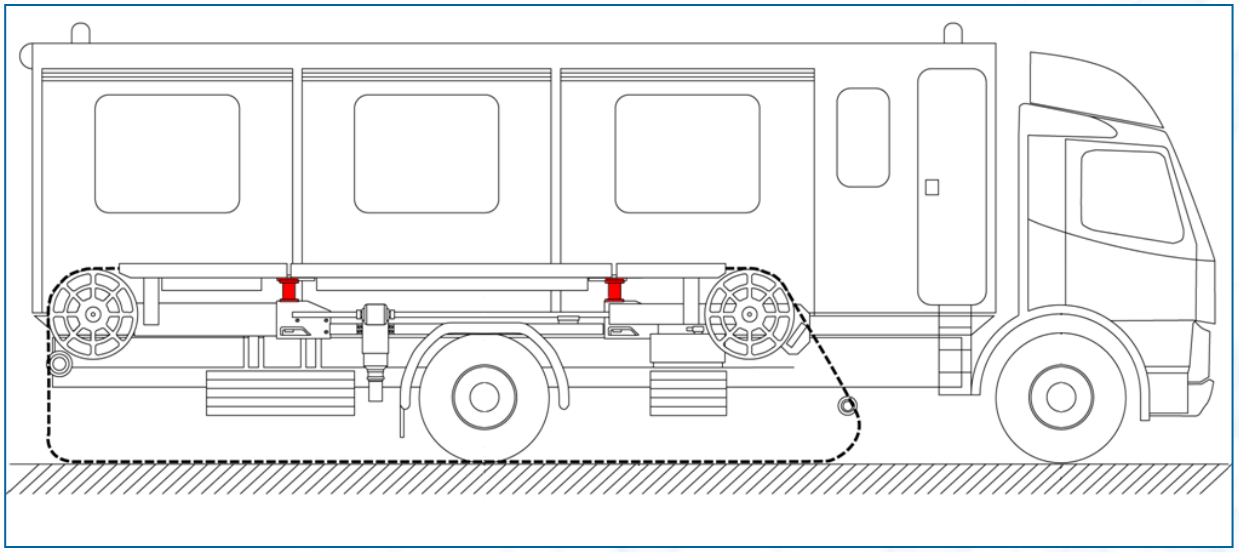
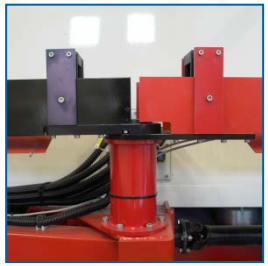
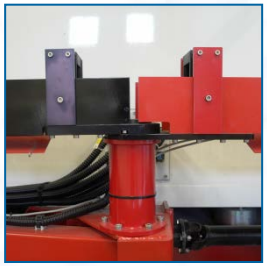
CURVIAMETER. Movement system

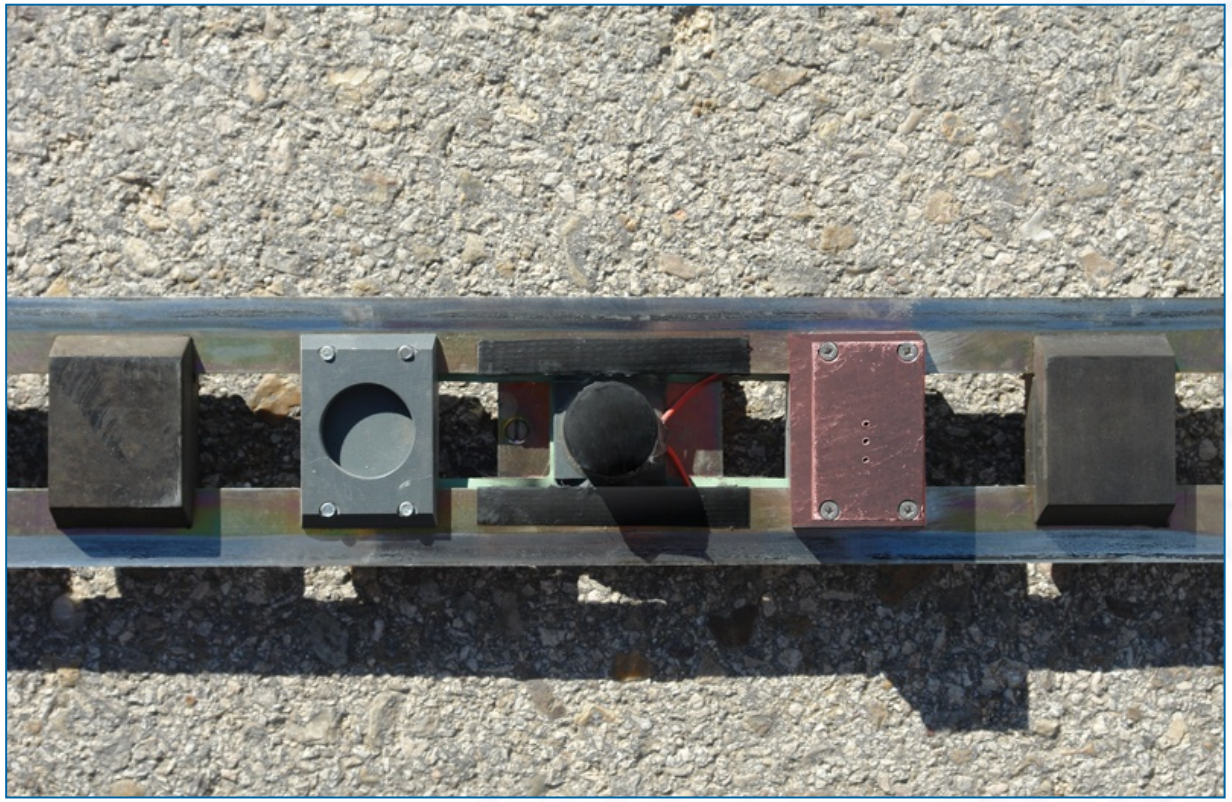






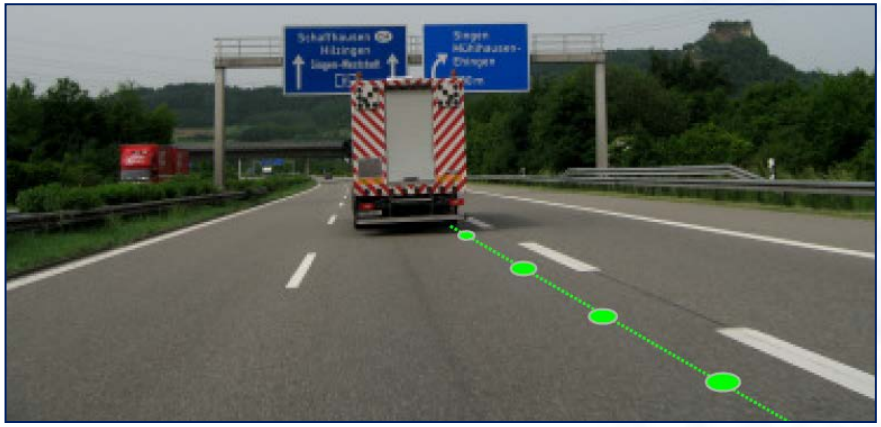
2. Curviameter System

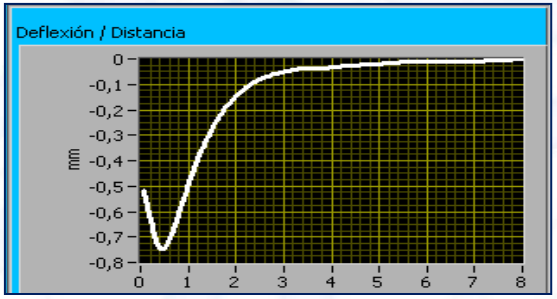
CURVIAMETER. Sensors. Geophones



2. Curviameter System

- Data collection is done with a measure speed of **5 m/s (18 km/h)**
- Each 5 m, pavement deflection is registered on a base length of 4 m (entire deflection bowl)
- Each deflection bowl is defined by 100 points





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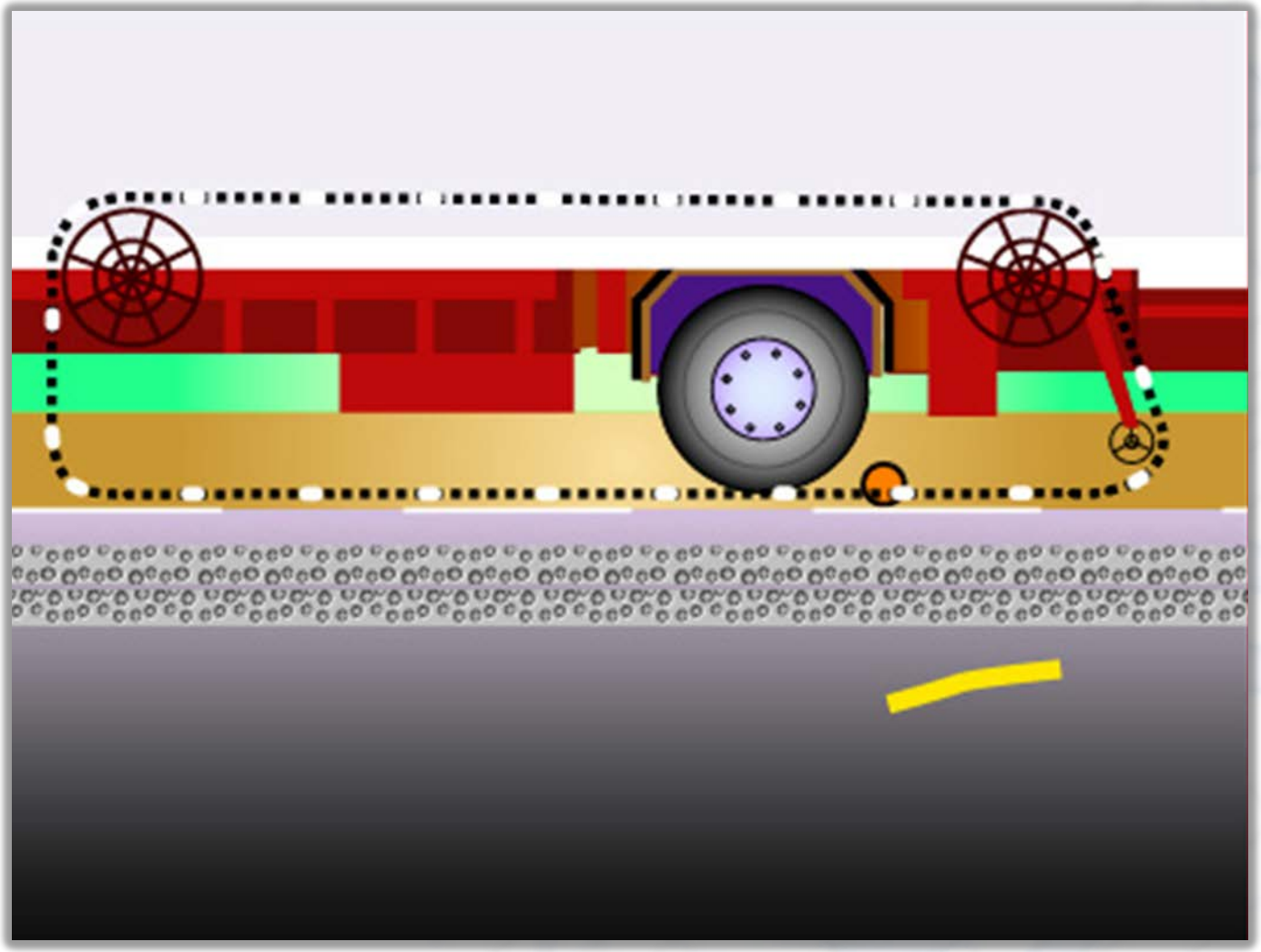

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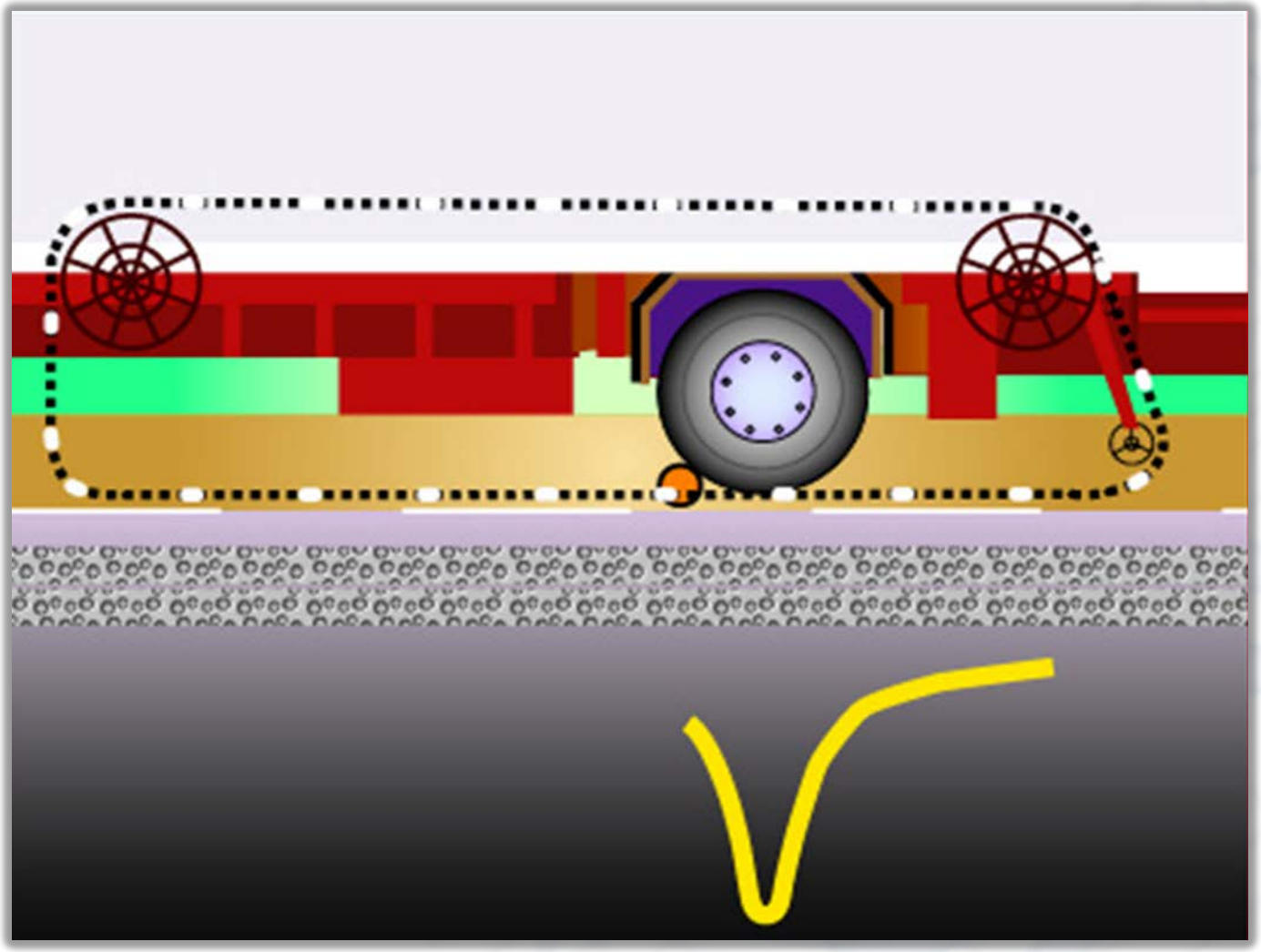

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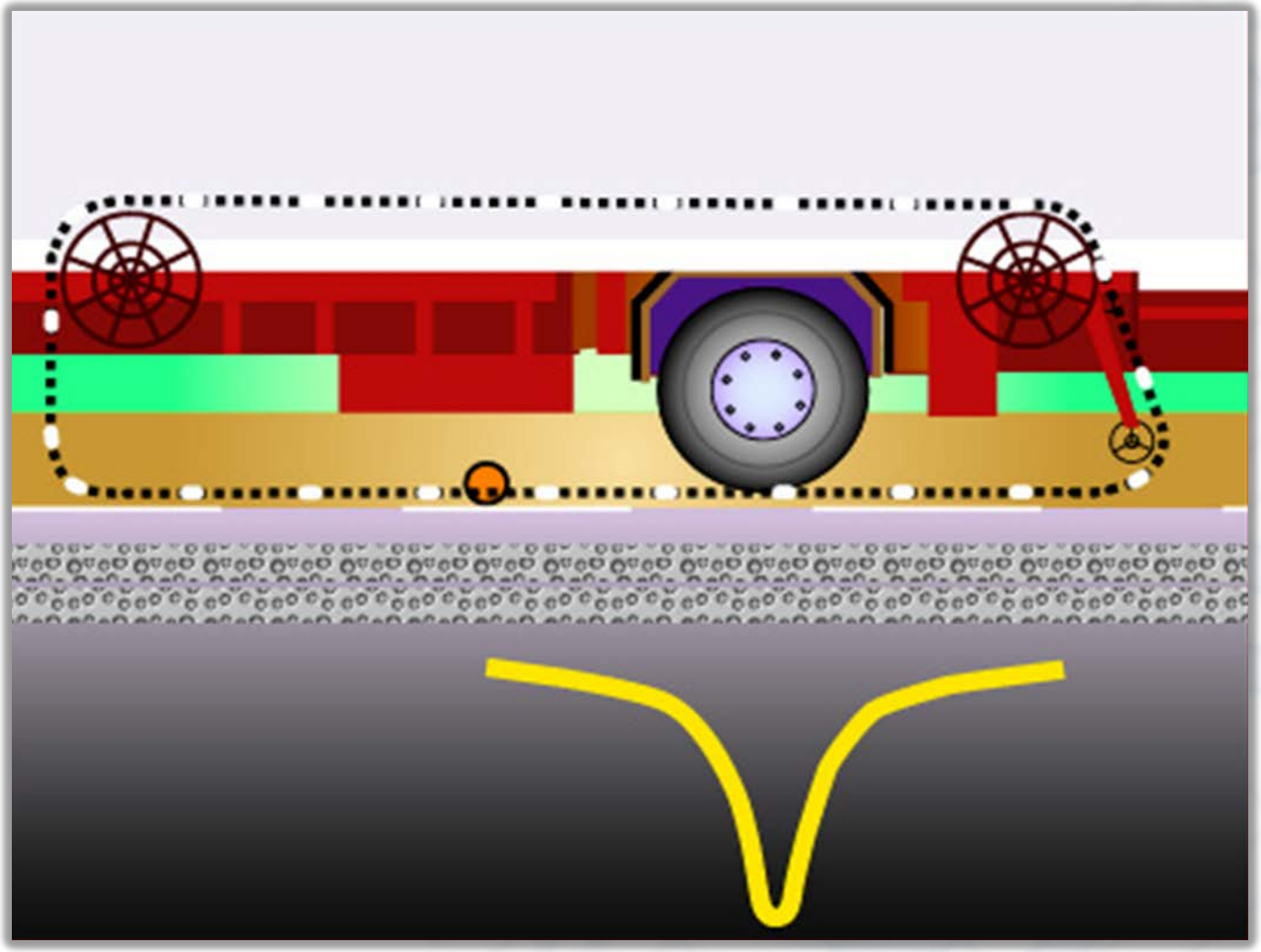

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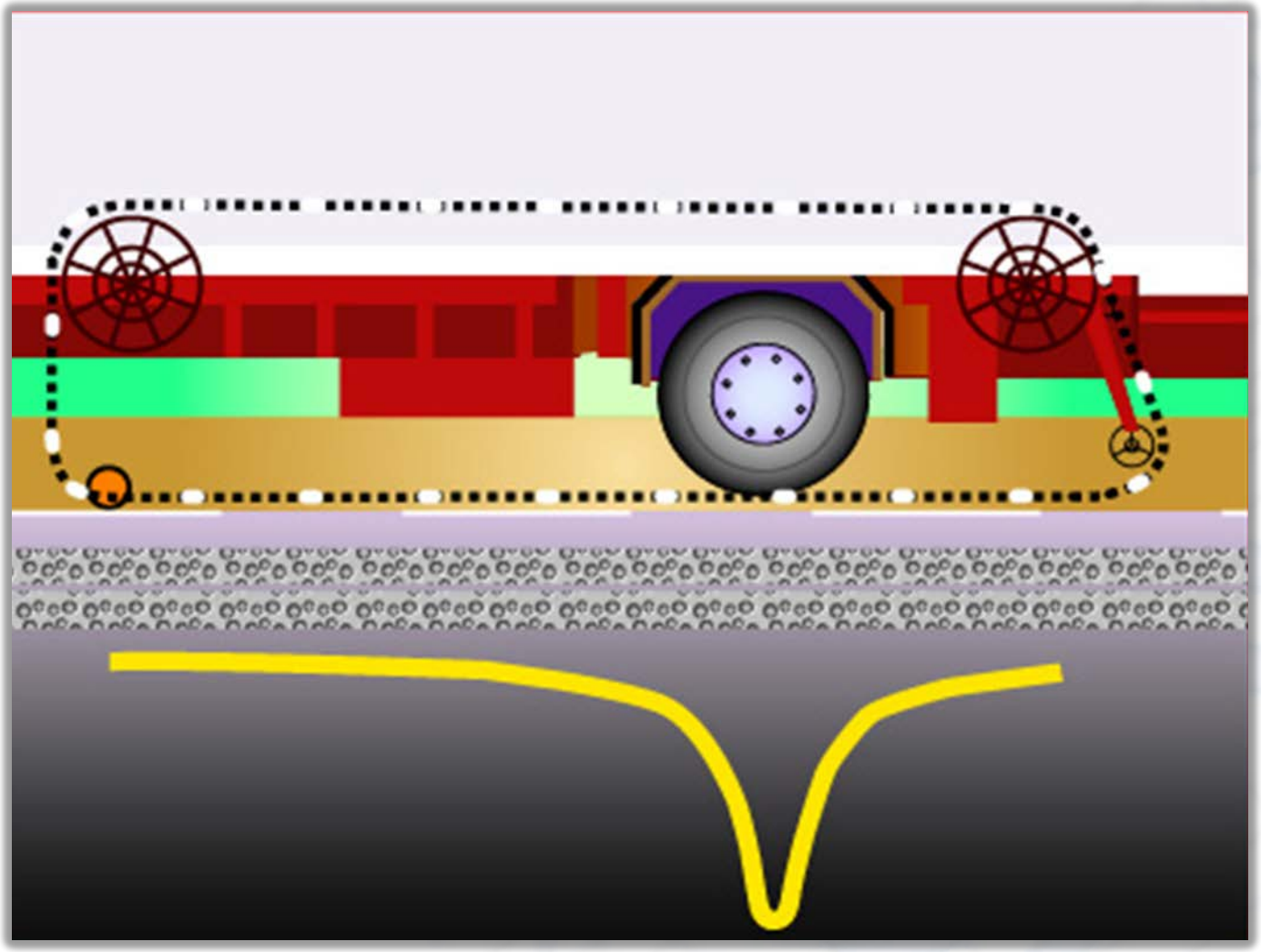


2. Curviameter System

- This high degree of precision permits the identification of **homogeneous zones** (statistic analysis)

2. Curviameter System

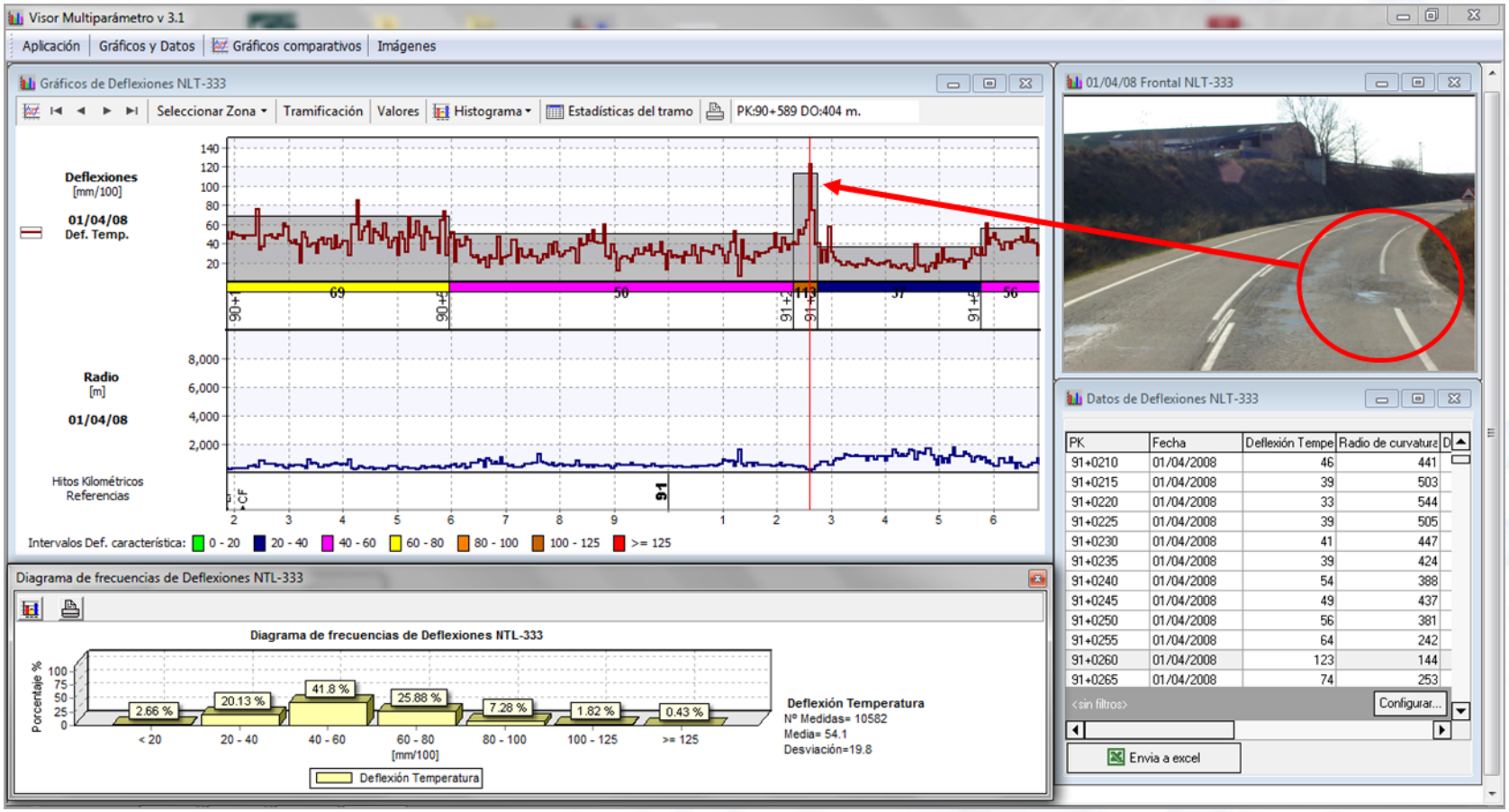
- Reduced time of lane occupation. The closing of the lane is not required

- It reduces costs and results in a great improvement in **road safety**

2. Curviameter System

2. Curviameter System

CURVIAMETER. GPS and Panoramic picture



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3. Curviameter Fields of Application

Fields of application included in* NLT-333 *standard

- ✓ Management of road networks (Type I)
- ✓ At the project level (Type II)
- ✓ Control during the construction (Type III)

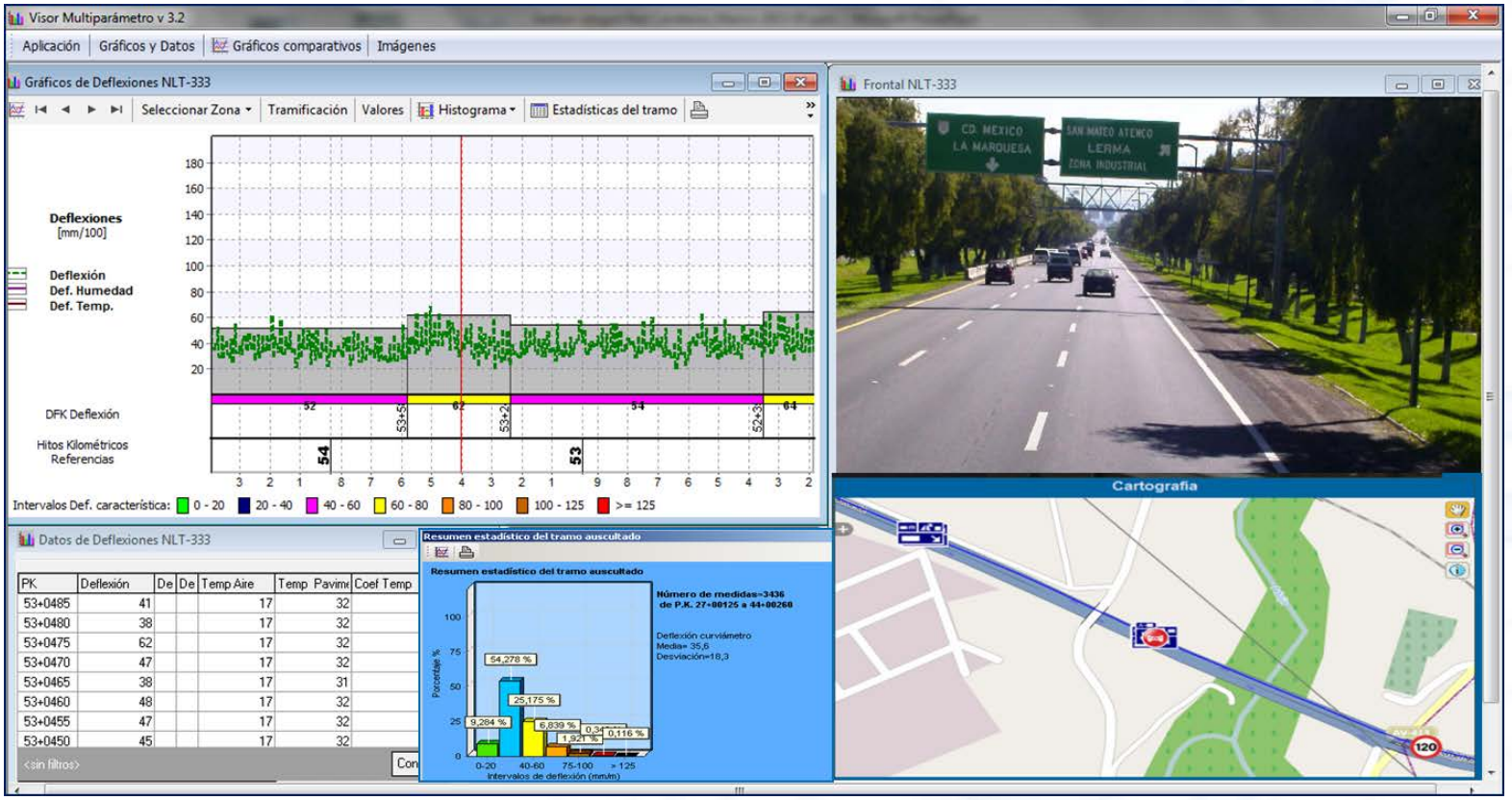
3. Curviameter Fields of Application

APPLICATION AREA.- Management of road networks (Type I)

Tool for a general evaluation of the structural conditions of pavements.

APPLICATION AREA.- At the project level (Type II)

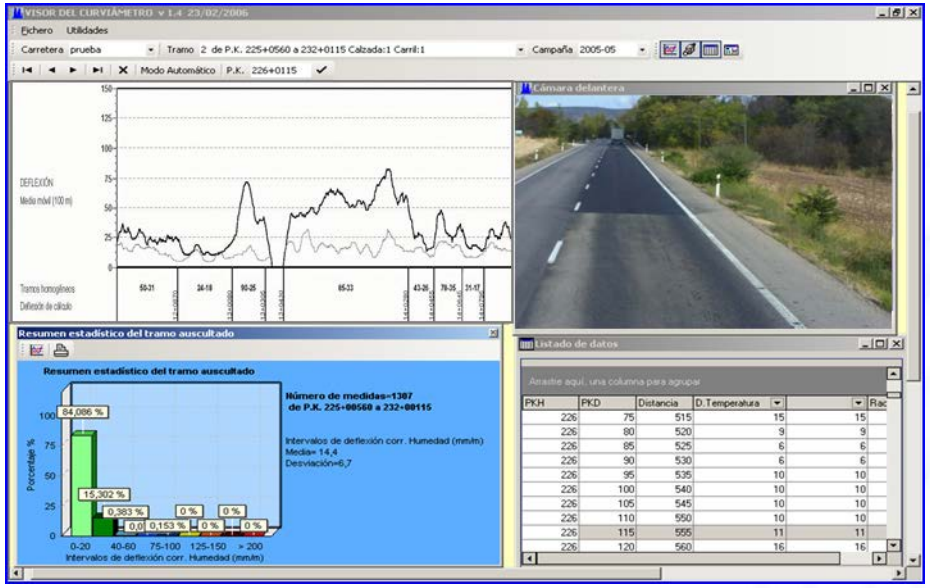
Decision-making techniques for the design of the rehabilitation needs.

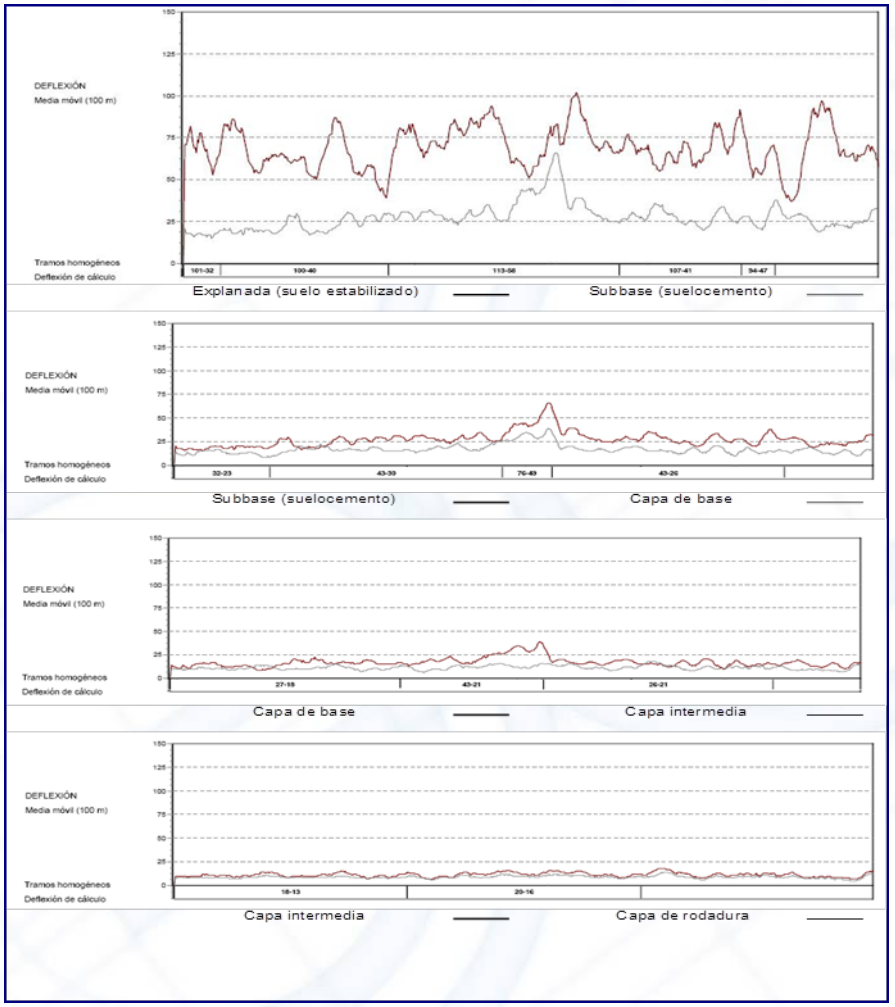


3. Curviameter Fields of Application

APPLICATION AREA.-

Control during the construction (Type III)





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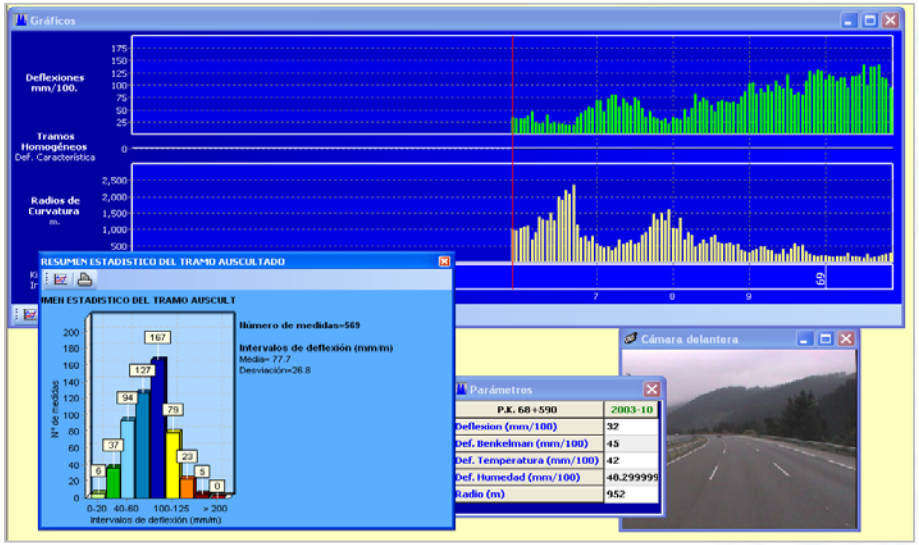
3.1. Management of road networks (Type I)

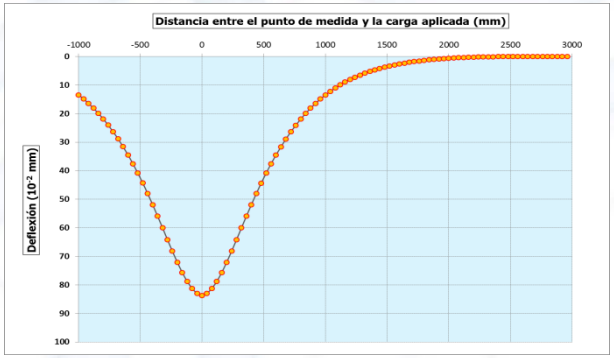
Examples of road networks surveyed > 10 000 km / year

3.1. Management of road networks (Type I)

Measurement system

- *Device*: **Curviameter**
- *Data collection speed*: **18 km / h (≈ 11 mi / h)**
- *Average performance*: **100 km / day (≈ 62 mi / day)**
- *Sample rate*: **1 entire deflection bowl every 5 m (≈ 196 in)**

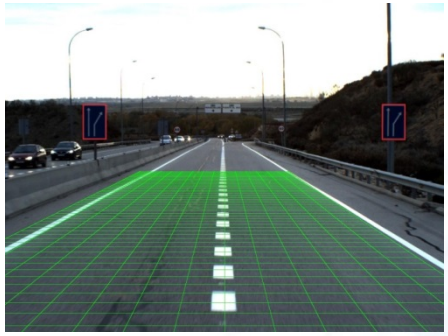


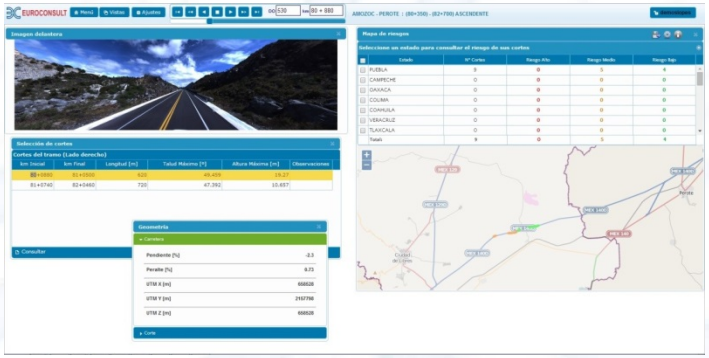


Homogeneous sections

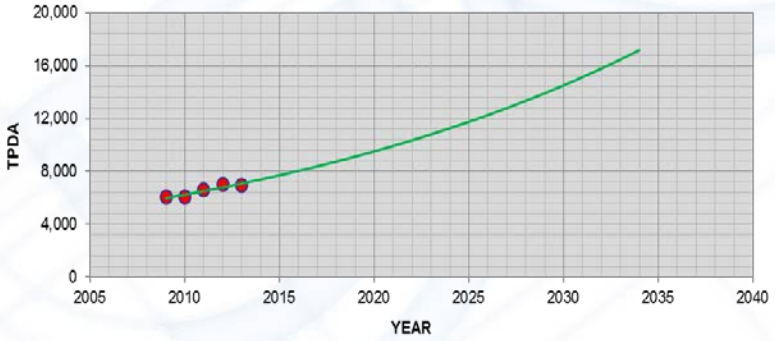
Deflection results are combined with other information (geometry, traffic, pavement structure, climate, among others) to determine **sections with a homogeneous behavior**

- **Geometry**



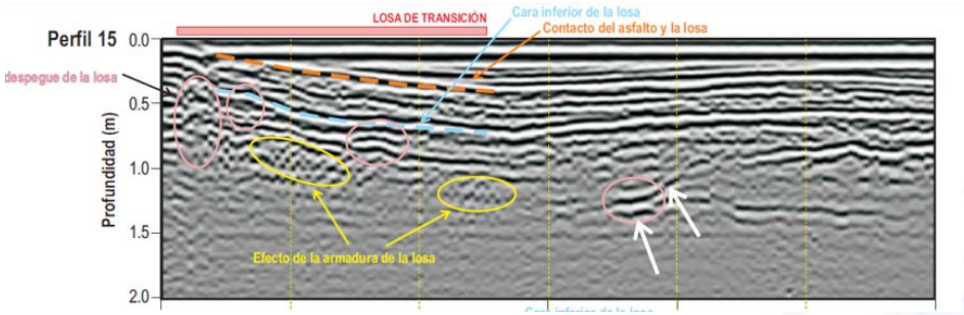


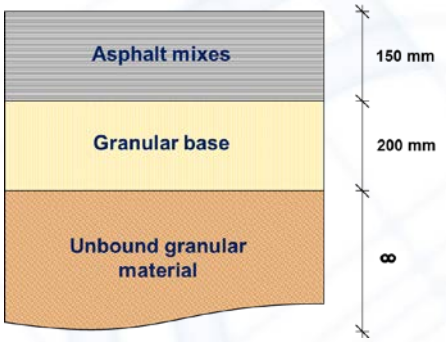
- **Traffic**

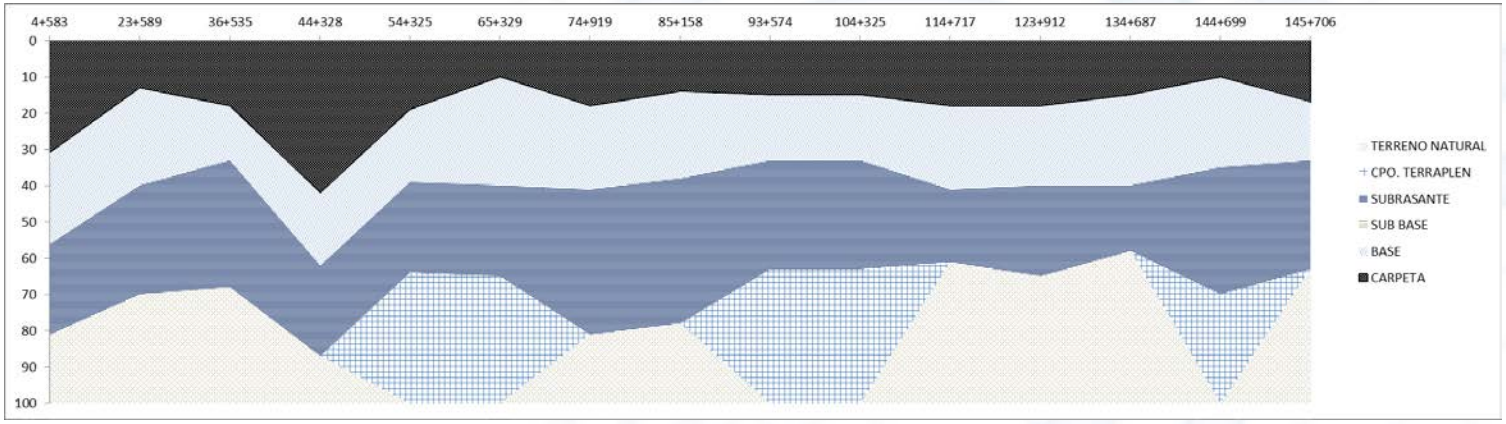


3.1. Management of road networks (Type I)

- **Pavement structure**

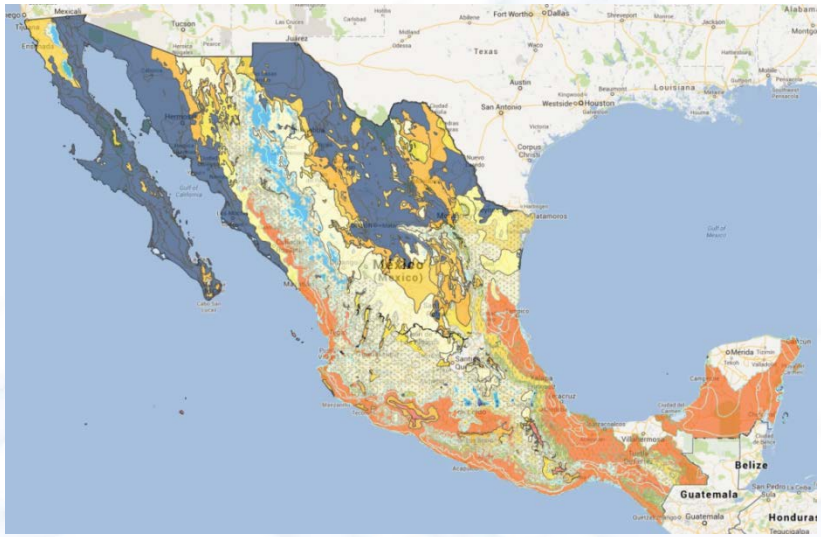






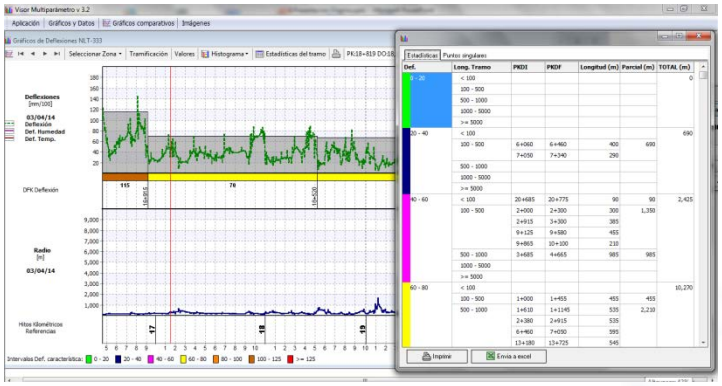
3.1. Management of road networks (Type I)

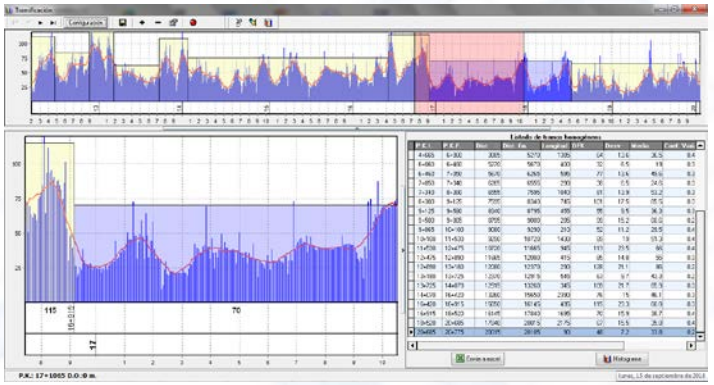
- **Climate**

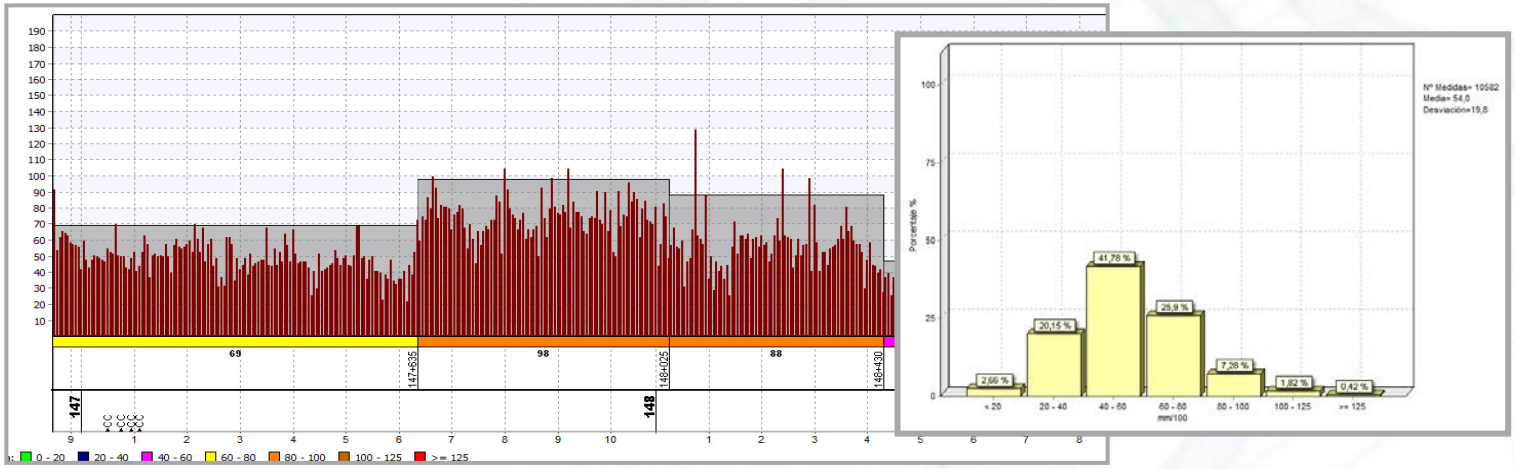


3.1. Management of road networks (Type I)

Sections with homogeneous behavior



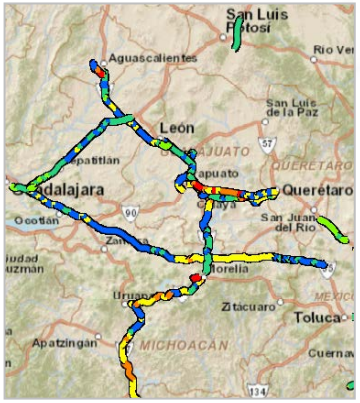




3.1. Management of road networks (Type I)

Performance Indicators based on deflections

- Maximum Deflection
- D x R
- Deflection bowl area
- Residual life
- Others



3.1. Management of road networks (Type I)

DEFLECTION (10^{-2} mm)	TRAFFIC TYPE		
	T00	T0	
0 - 40	10	PREC	
40 - 60	12	10	
60 - 80	15	12	
80 - 100	18	15	
100 - 125		18	
125 - 150			
150 - 200			
> 200		SPE	

3.1. Management of road networks (Type I)

Combination with other pavement characteristics

3.1. Management of road networks (Type I)

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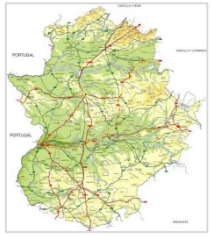
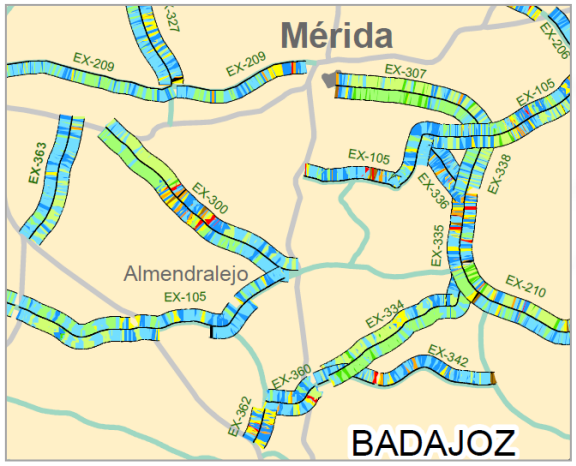
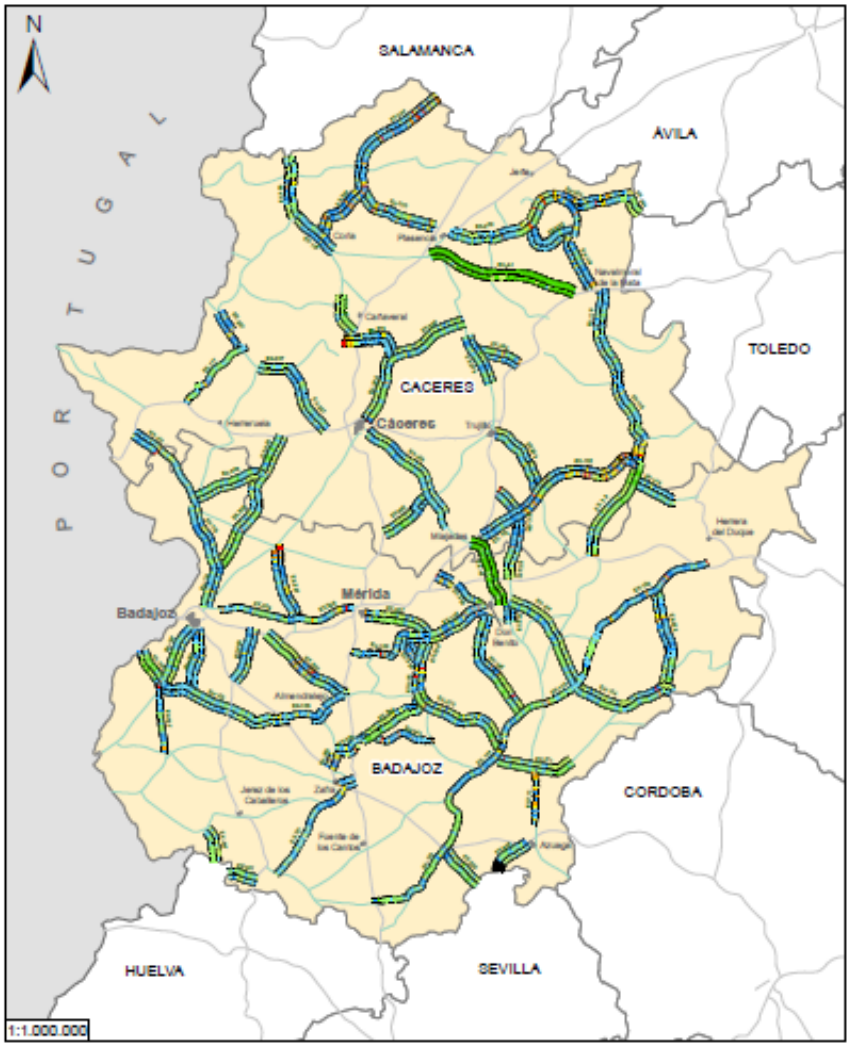




Longitudinal and transversal profile



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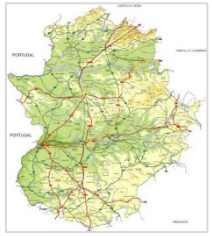
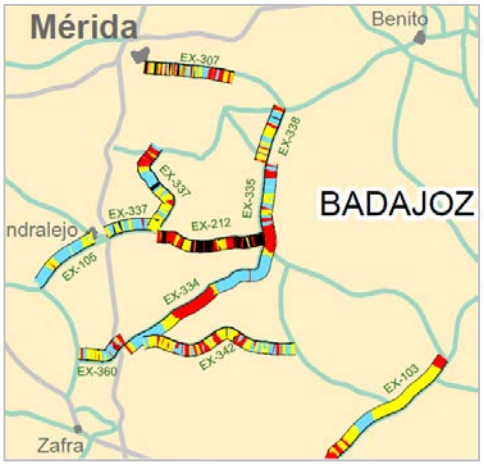
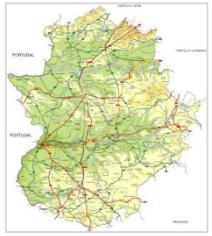
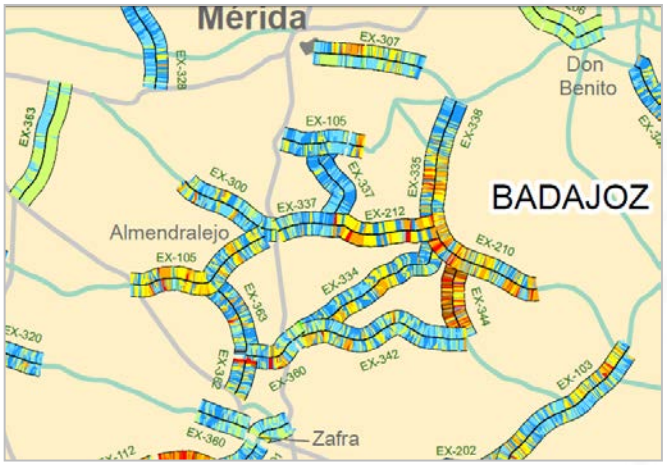




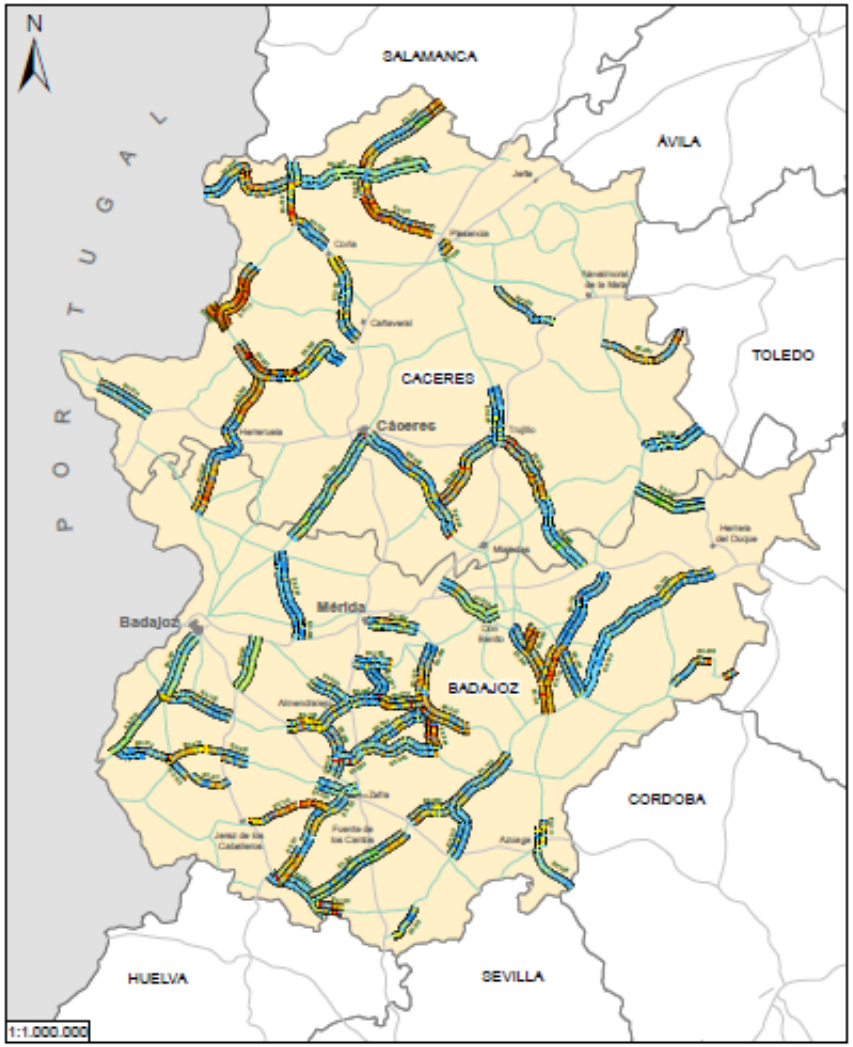
Skid resistance

3.1. Management of road networks (Type I)



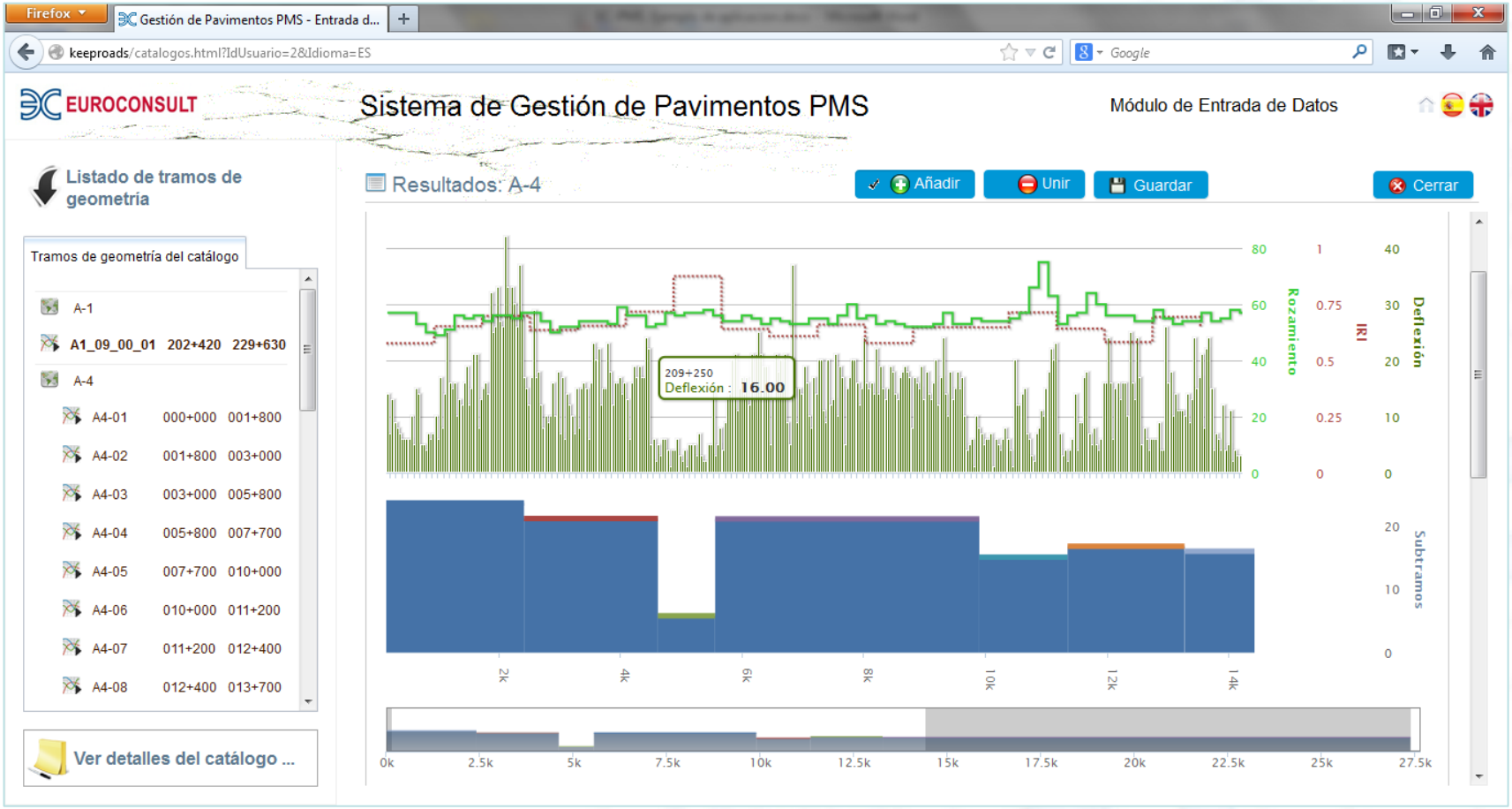


Cracks and damages



3.1. Management of road networks (Type I)

Homogeneous sections considering all parameters



3.1. Management of road networks (Type I)

PMS

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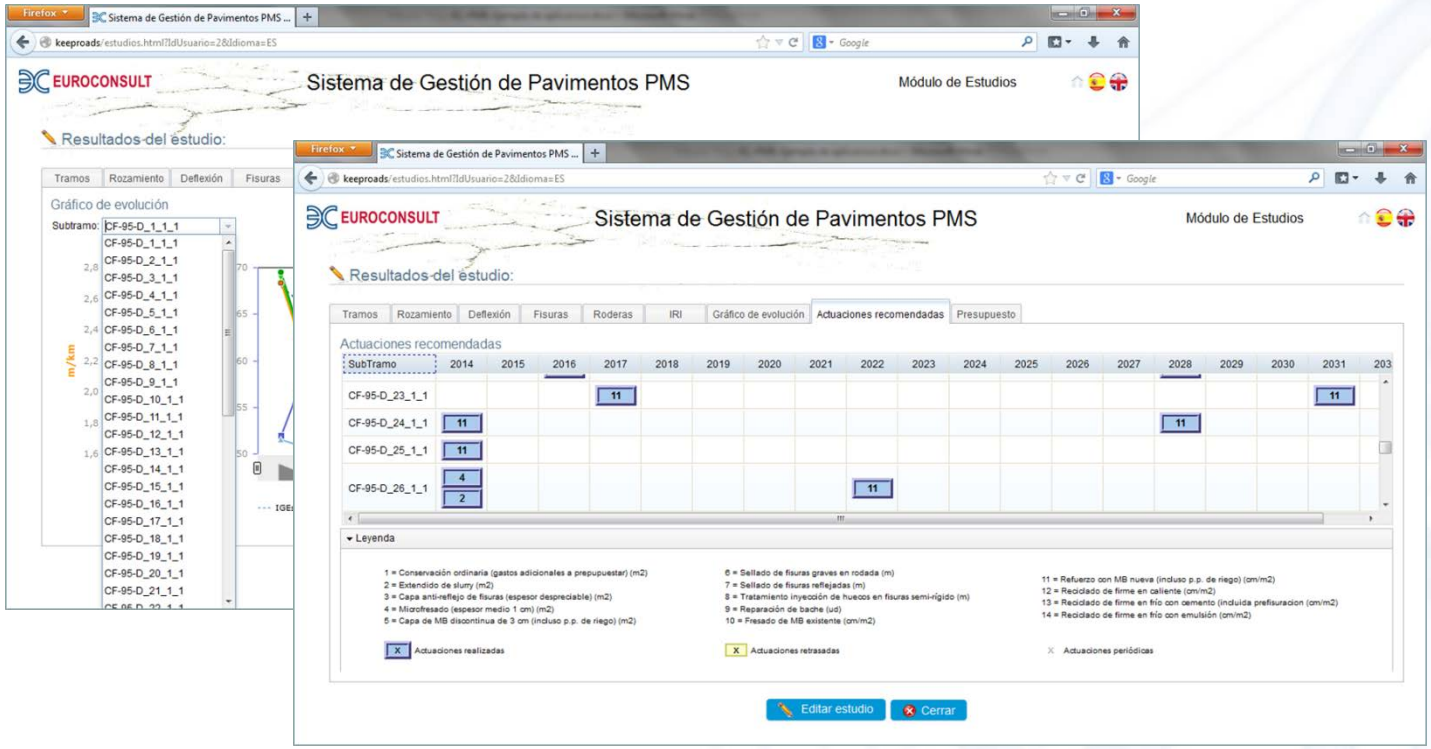
PMS



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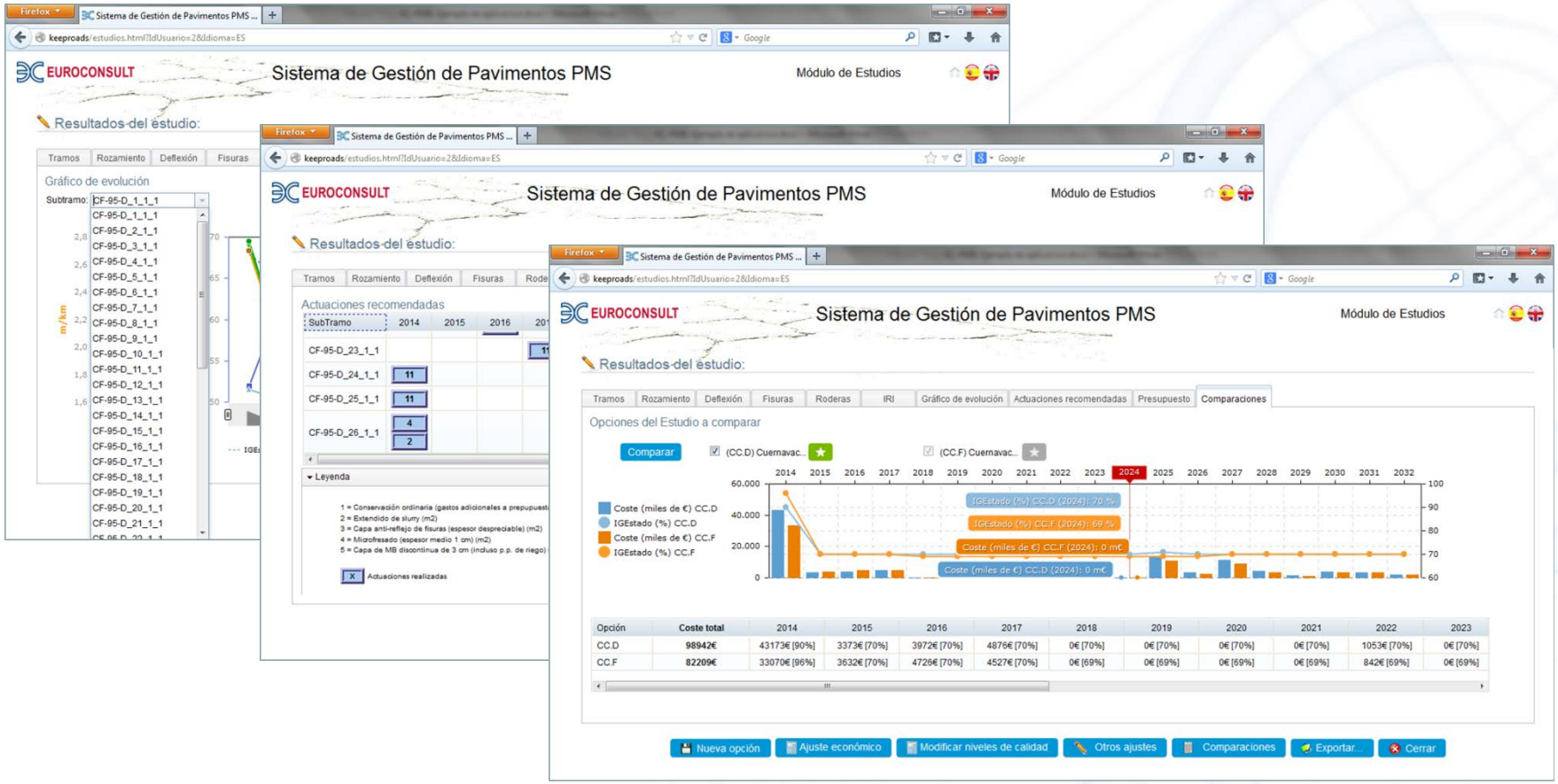
PMS



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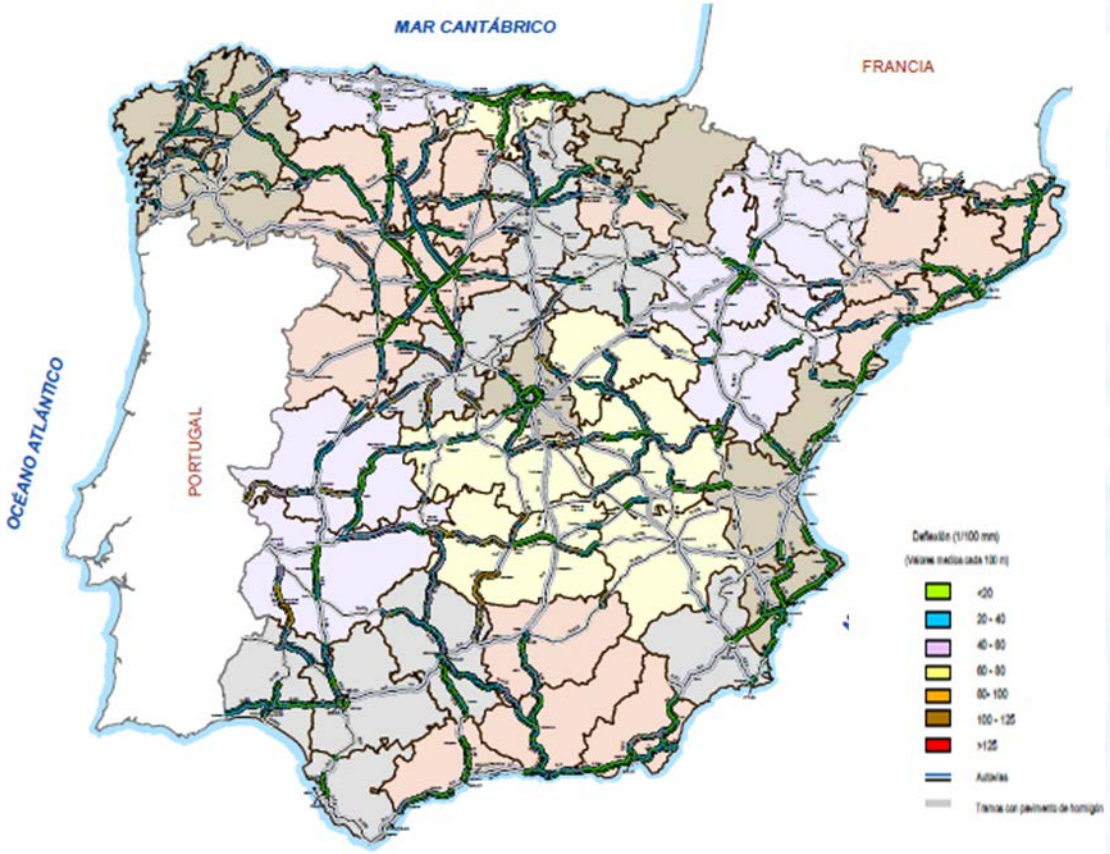
3.2. At the project level (Type II)

Deflection data. Curviameter device



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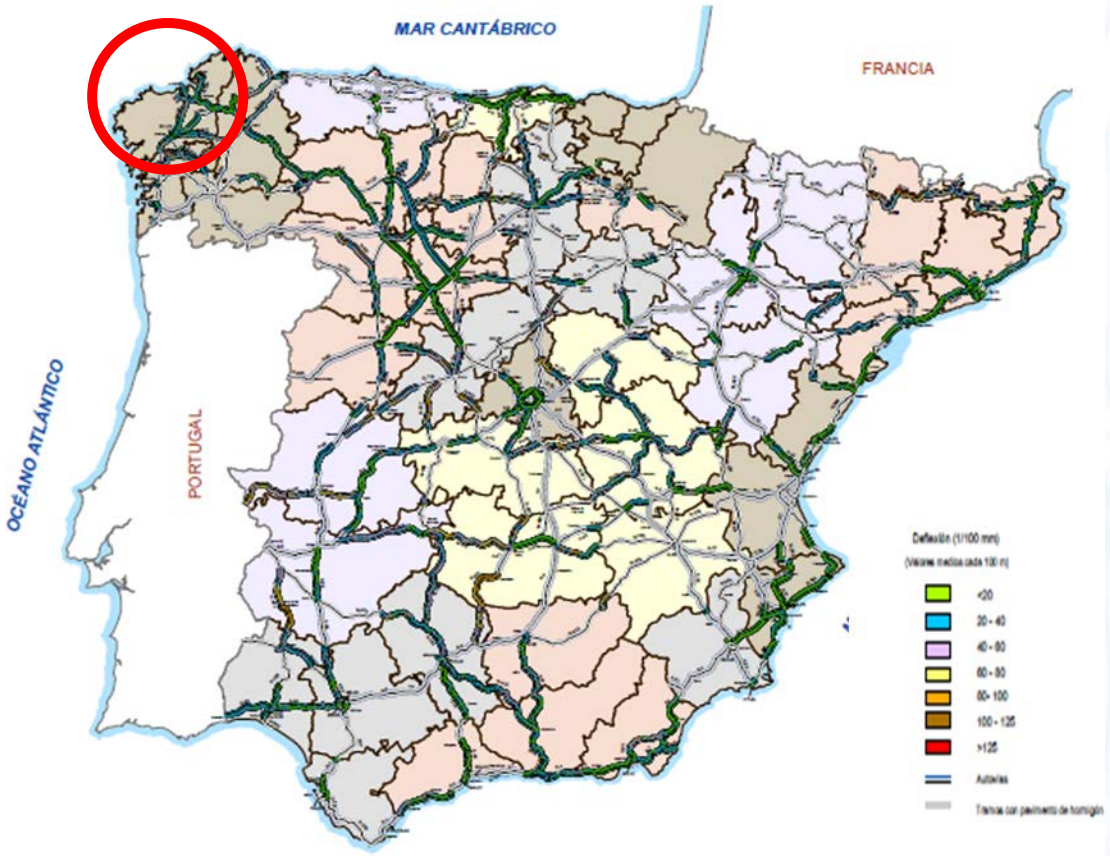

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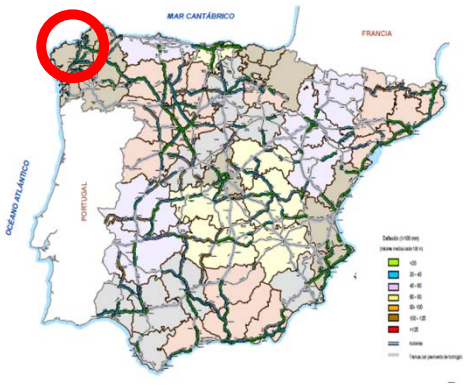
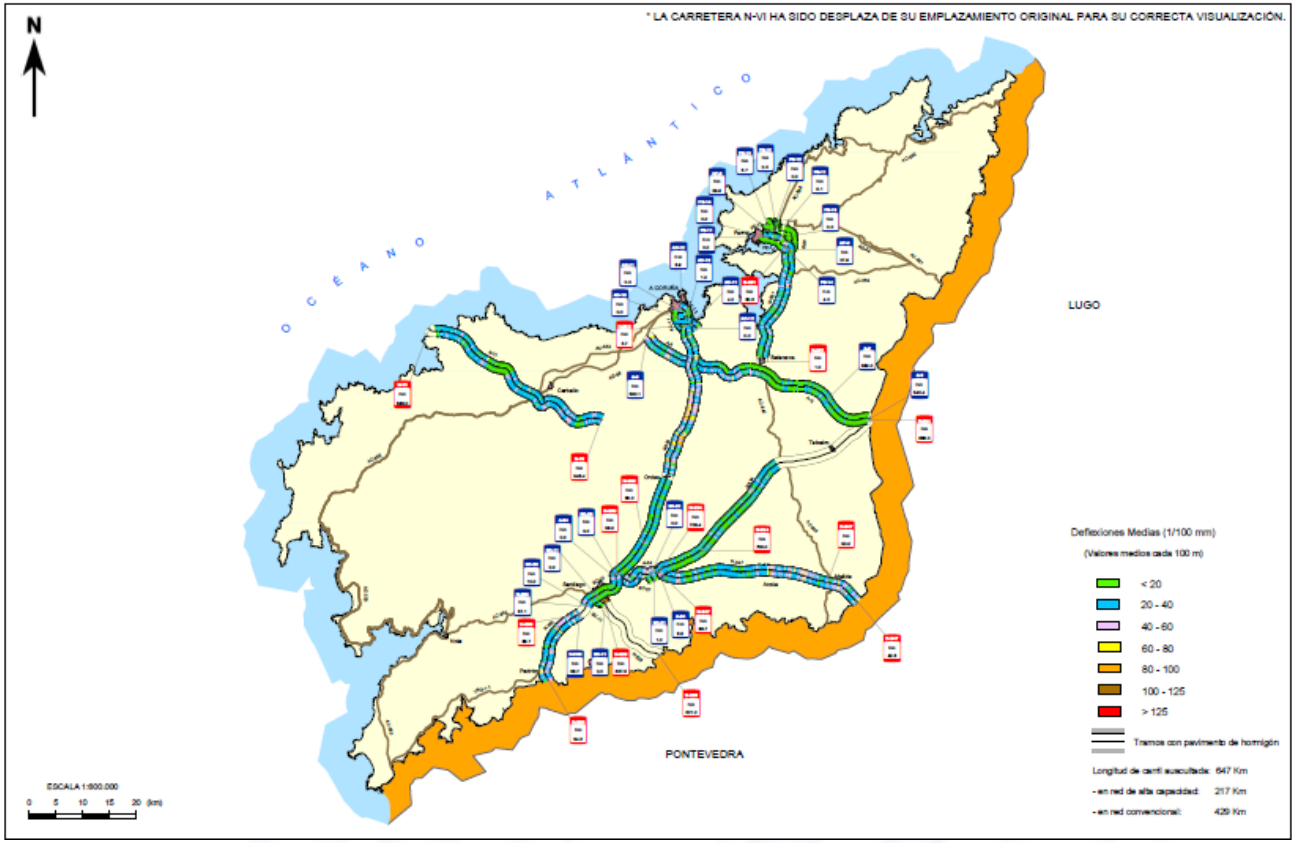
Deflection data. Curviameter device





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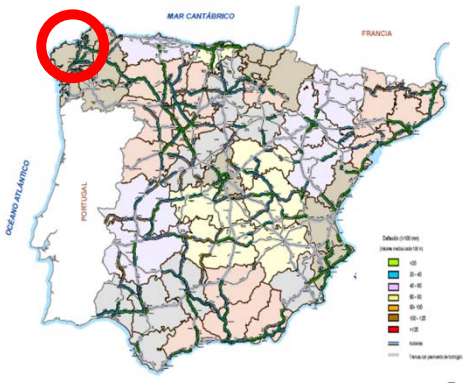
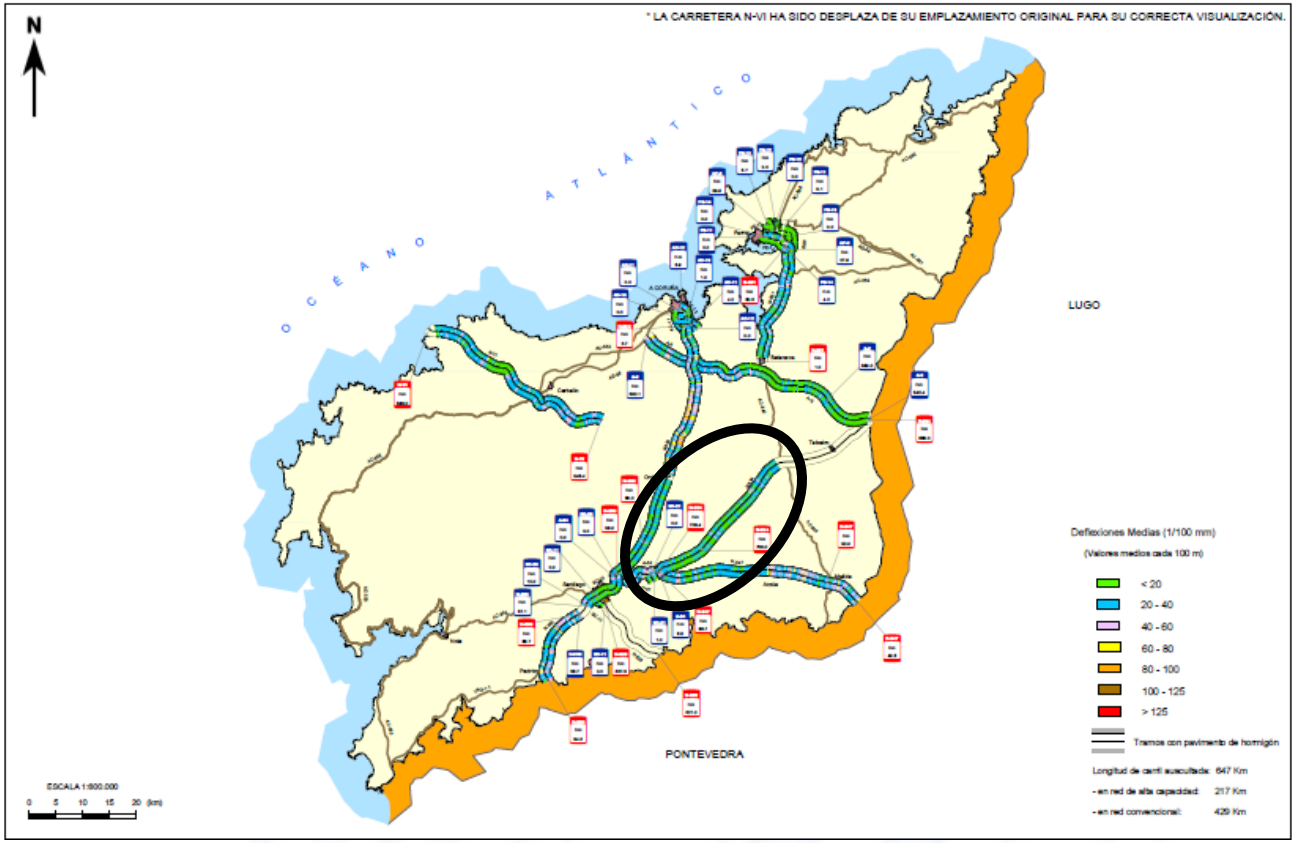
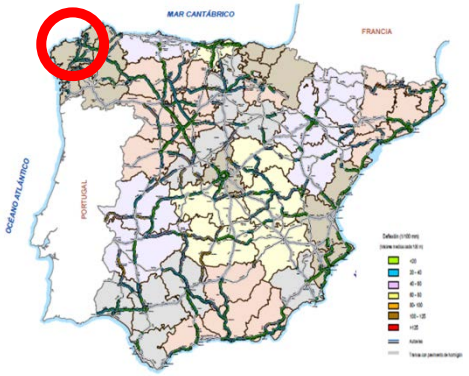
Deflection data. Curviameter device

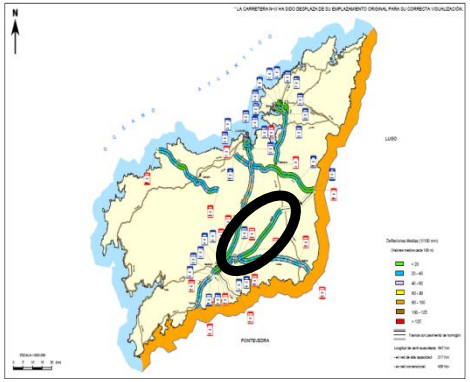


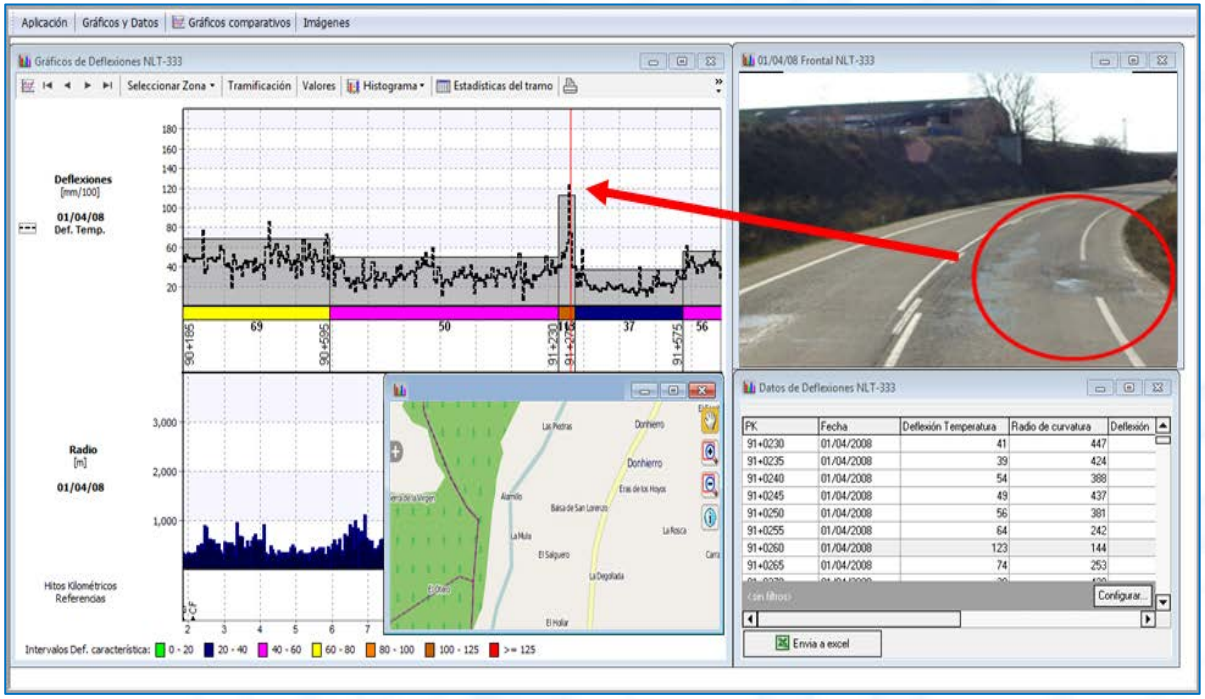


3.2. At the project level (Type II)

Deflection data. Curviameter device



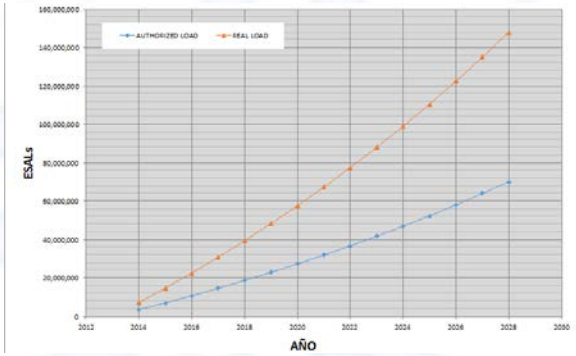


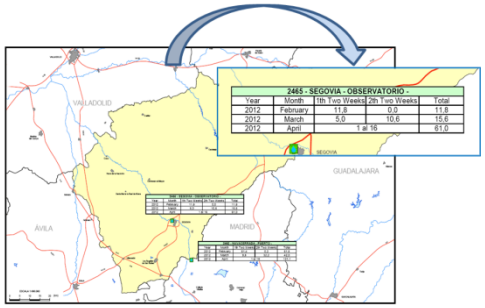


3.2. At the project level (Type II)

Additional detailed information

- Traffic
- Pavement and subgrade structure
- Material laboratory tests
- Climate
- Geometry
- Drainage
- Cracks and damages
- Functional parameters
- Other useful information



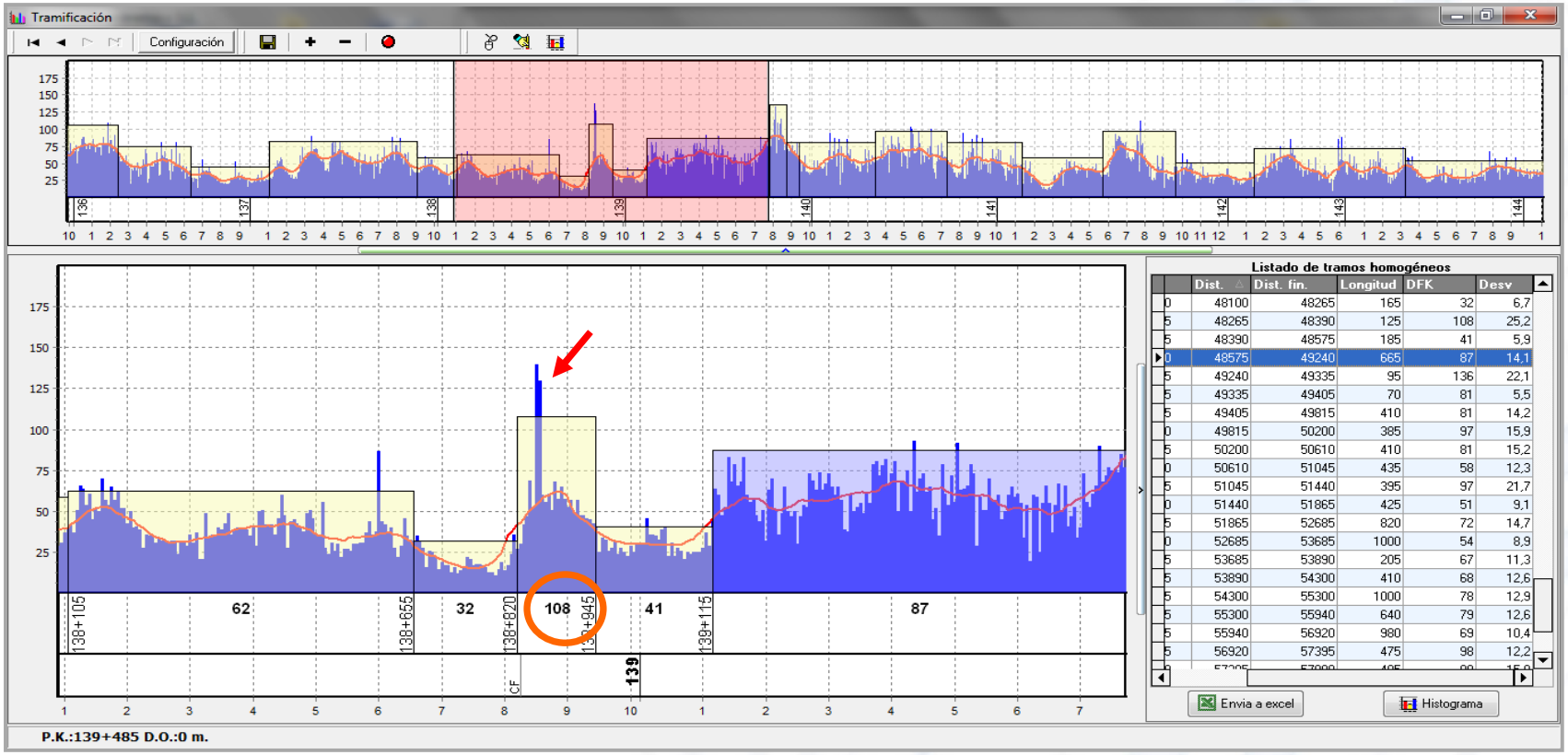


3.2. At the project level (Type II)

Sections with homogeneous behavior

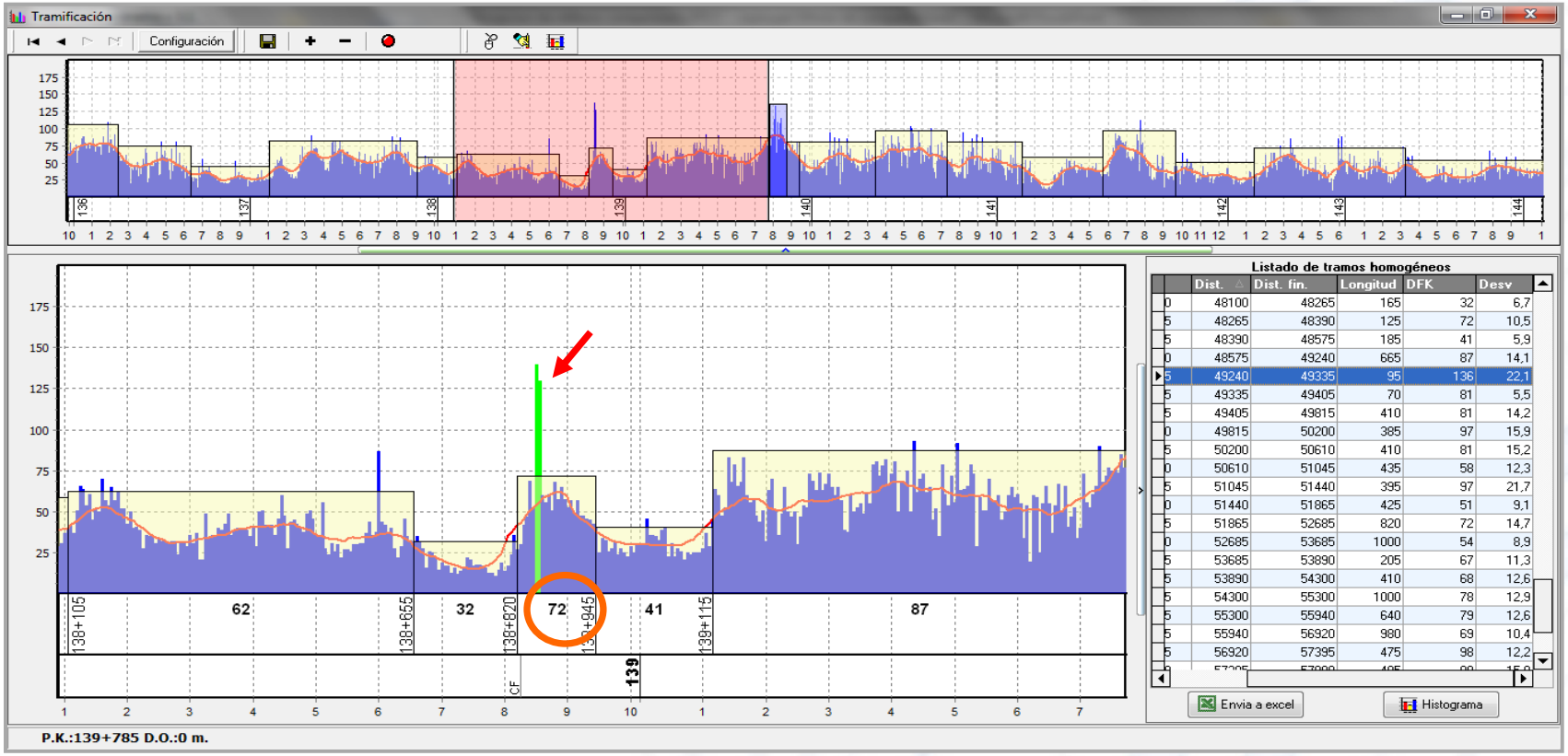
3.2. At the project level (Type II)

Detailed study



3.2. At the project level (Type II)

Detailed study



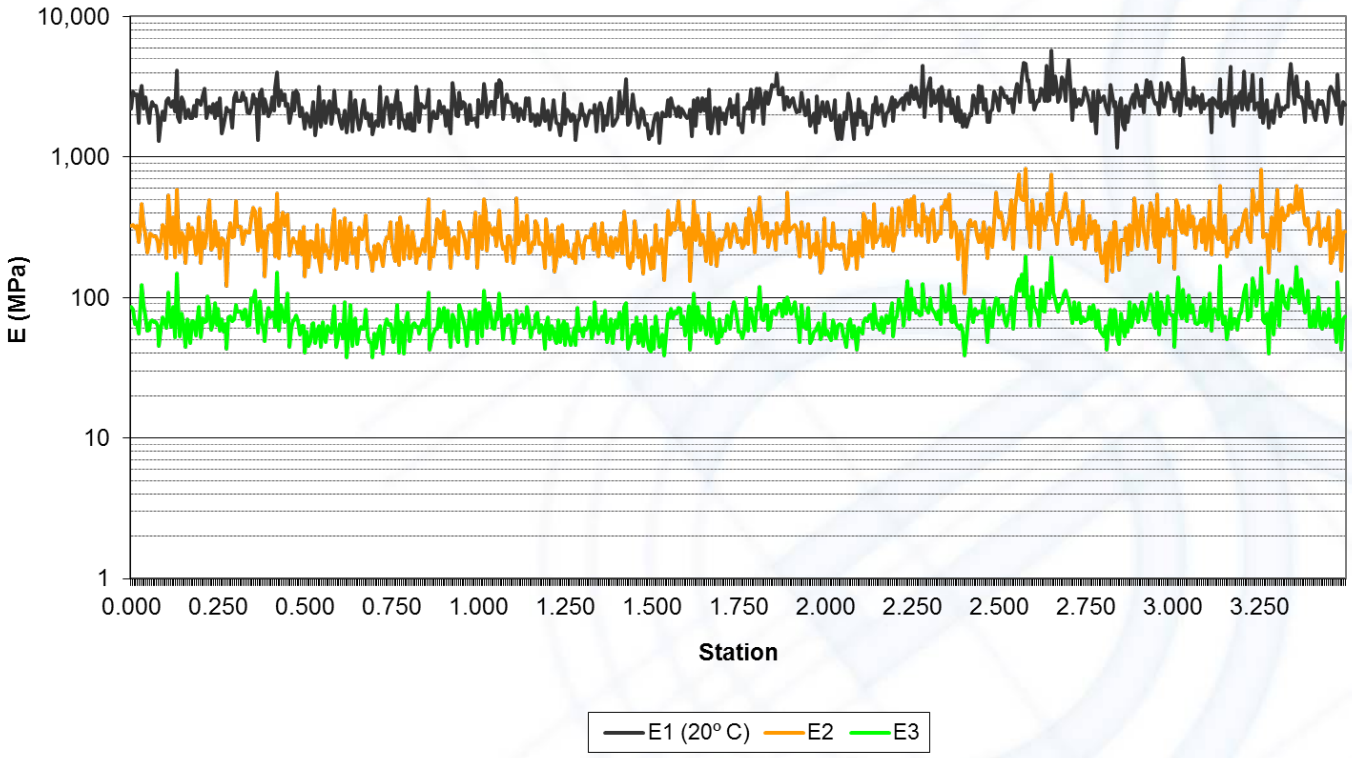
3.2. At the project level (Type II)

Moduli of each layer

Back-calculation using the entire deflection bowl (1 data every 5 m)

Moduli of each layer

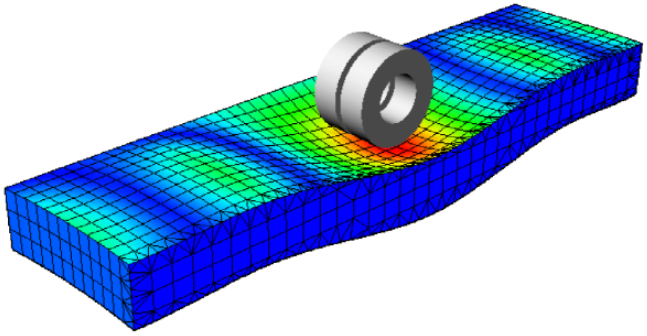
Back-calculation using the entire deflection bowl (1 data every 5 m)



Mechanistic analysis . Pavement response

Deflection, stress and strain using Multilayer or 3-D finite element programs

- *Static / Dynamic load*
- *Linear / non linear*
- *Elastic / Viscoelastic*
- *Others*



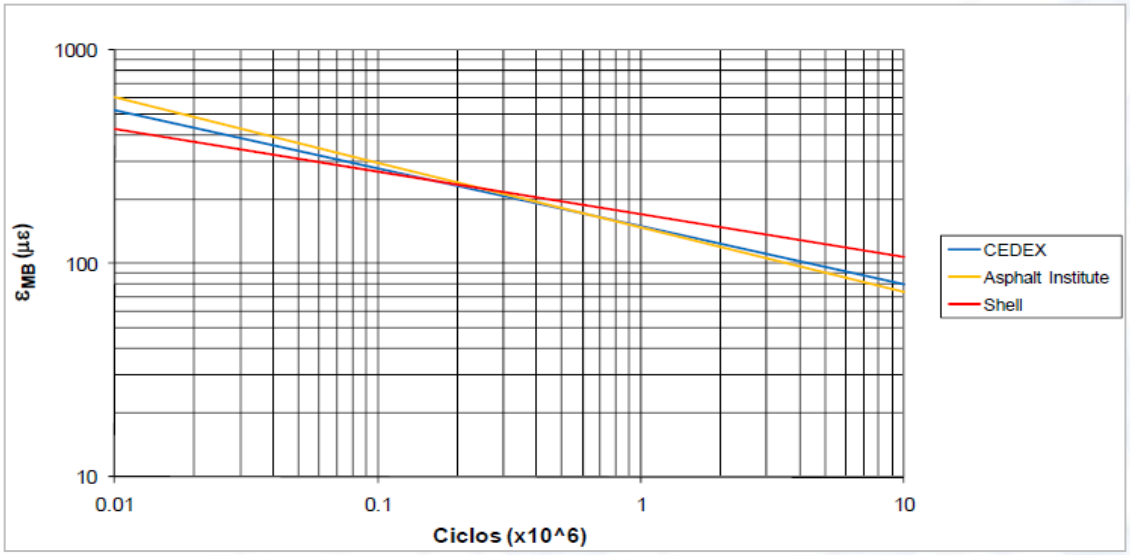
Título del Trabajo : Semirrigidos
Número de Capas : 3 Alternativa : 1

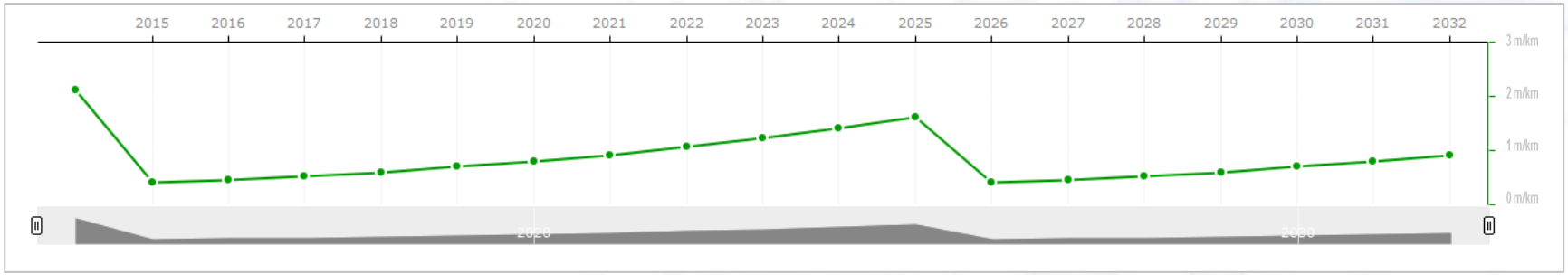
Capa Nº	Z (cm)	Epsilon T	Sigma T (Kg/cm²)	Epsilon Z	Sigma Z (Kg/cm²)
1ª	0.00	5.2600E-05 B	9.6362E+00 B	-4.2300E-05 C	9.0040E+00 A
	5.00	3.3000E-05 C	7.1073E+00 B	-2.8800E-05 C	8.3921E+00 A
					Ligada
2ª	5.00	3.3000E-05 C	8.8102E+00 B	-1.4600E-05 C	8.3921E+00 A
	30.00	-4.5500E-05 C	-9.9829E+00 C	2.0100E-05 B	1.1319E-01 C
					No Ligada
3ª	30.00	4.0700E-05 C	9.7483E-02 C	7.6600E-05 C	1.1319E-01 C

Deflexión = 36.340 mm/100
Radio de Curvatura = 2113.890 m

3.2. At the project level (Type II)

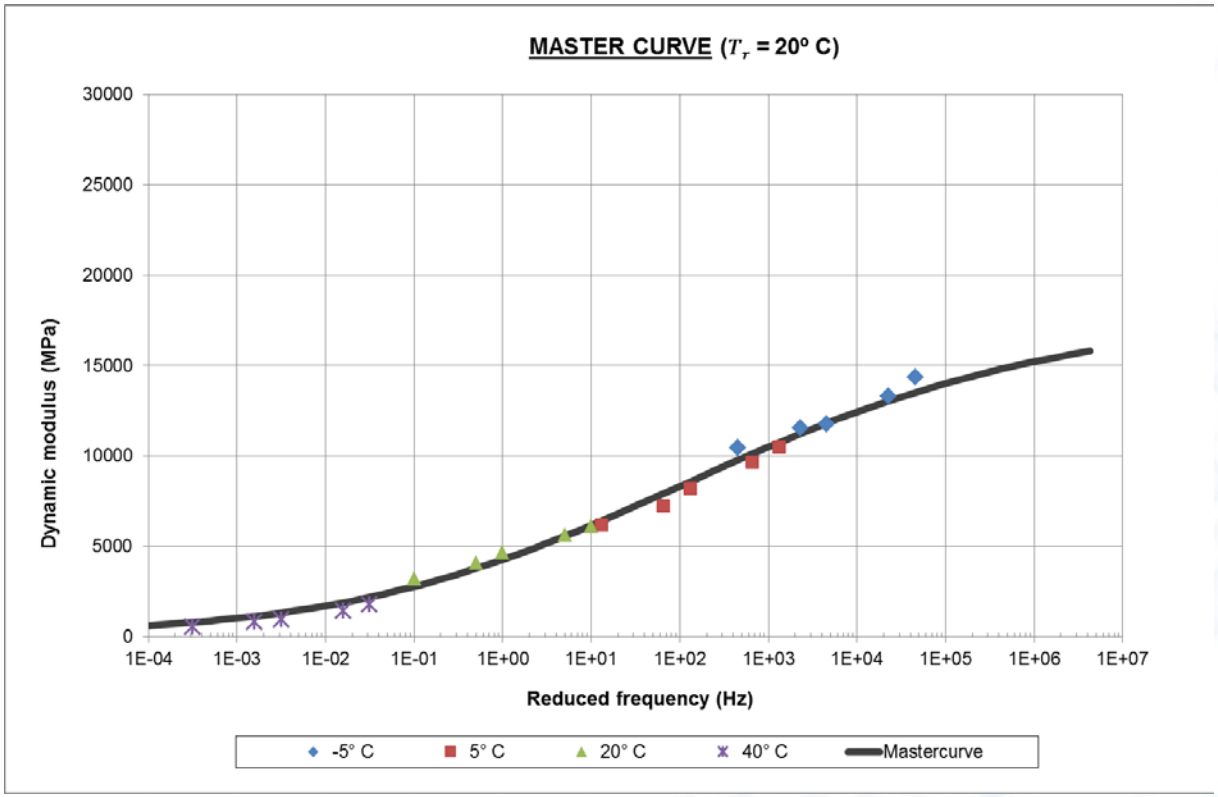
Prediction models





3.2. At the project level (Type II)

Prediction models



3.2. At the project level (Type II)

Definition of the rehabilitation solution

- Reconstruction
- Full-depth repair
- Partial-depth pavement repair
- Joint and cracks sealing
- Overlay
- Surface treatment
- Others

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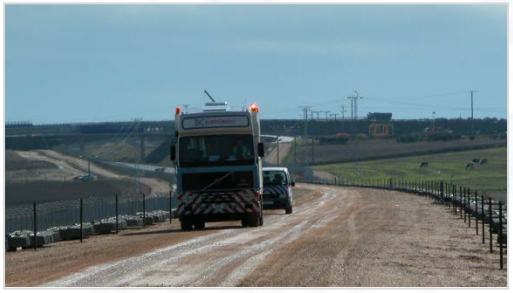
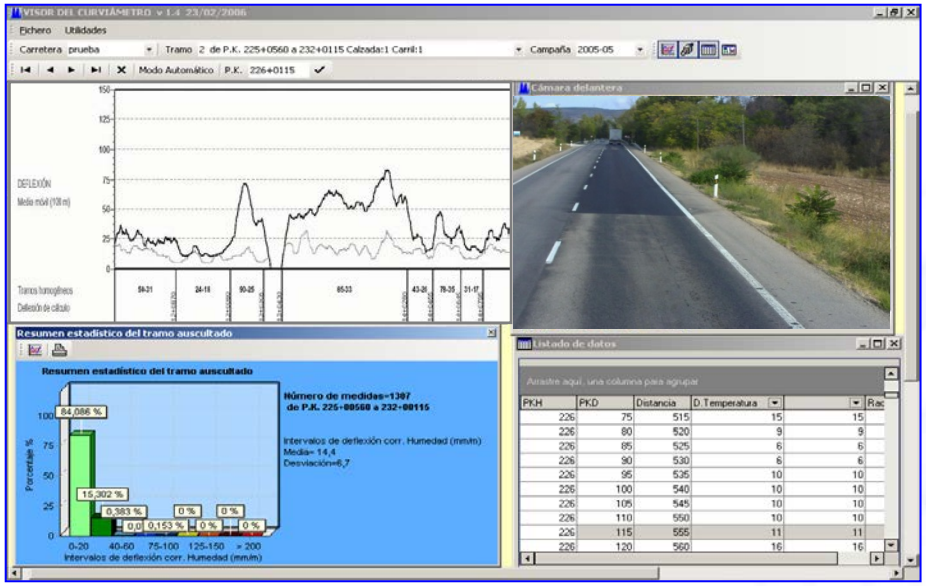
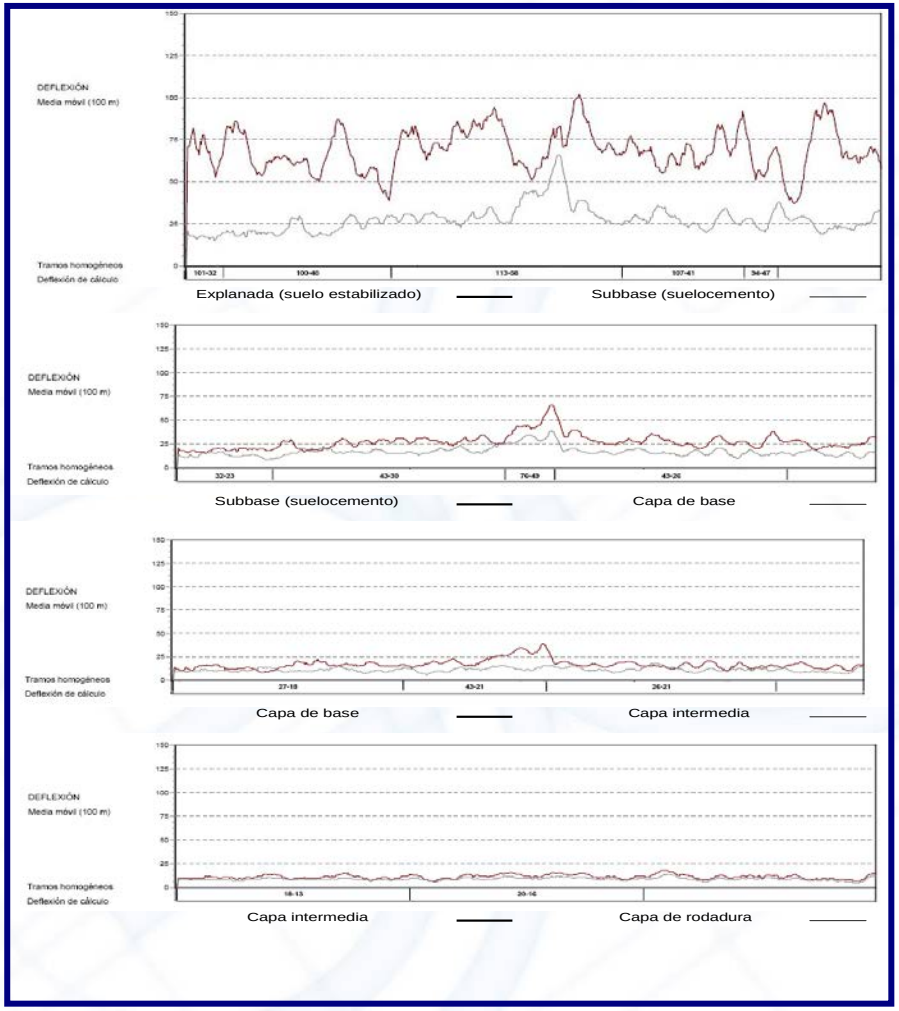
3.3. Control during the construction (Type III)

- Possibility of evaluating the structural behavior of **each pavement layer**
- **Comparison** between theoretical pavement response (mechanistic analysis) and Curviameter results
- Large amount of data allows homogeneity analysis during construction
- In addition, having information of the complete **constructive process** allows for right decisions during **maintenance**



3.3. Control during the construction (Type III)





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4. Conclusions

- Curviameter data collection: **18 km / h (≈ 11 mi / h)**
- Average performance: **100 km / day (≈ 62 mi / day)**
- Each **5 m (≈ 196 in)**, an entire deflection bowl is registered
- Each deflection bowl is defined by 100 points
- Collecting many data in **a short period of time**
- Minimizing time of **lane occupation** (closing of the lane is not required)
- Increasing **road safety** (less lane disruption time)

4. Conclusions

- Resources and investments are really optimized

- The system is used in the three application fields included in NLT-333 standard:
  - **Road network management**
  - **Project level**
  - **Construction control**

The Curviameter device collects pavement deflection data that can be used both at ROAD NETWORK MANAGEMENT and PROJECT LEVELS